GETTING DOWN TO FACTS II

Technical Report

A Portrait of California Career Technical Education Pathway Completers

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About: The *Getting Down to Facts* project seeks to create a common evidence base for understanding the current state of California school systems and lay the foundation for substantive conversations about what education policies should be sustained and what might be improved to ensure increased opportunity and success for all students in California in the decades ahead. *Getting Down to Facts II* follows approximately a decade after the first *Getting Down to Facts* effort in 2007. This technical report is one of 36 in the set of *Getting Down to Facts II* studies that cover four main areas related to state education policy: student success, governance, personnel, and funding.

Stanford University

PACE Policy Analysis for California Education

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Introduction

In order to meet the increasing demands of the workforce, and to improve alignment between high school programs and labor market needs, state systems of education are looking closely at Career Technical Education (CTE) pathways in public schools. In California, career and technical education, in both K-12 and community college, is increasingly seen as an important tool for the State to meet the changing needs of the labor market. Alongside the recognition that education can help meet labor market demand is the increased awareness that education should match the specific personal and professional interest of students (Holzer, Linn, & Monthey, 2013). In this way, career-technical education (CTE) can address both economic development and educational outcomes. Moreover, it can potentially play an important role in reducing persistent educational and economic disparities for students from different socioeconomic, racial/ethnic, and English Learner backgrounds. Evidence of the increasing focus on CTE at the national level was codified in the most recent reauthorization of the Elementary and Secondary Education Act. The Every Student Succeeds Act (ESSA) emphasizes students' college *and* career readiness, a departure from early policy focused only on the former.

Multiple efforts in California aimed at enhancing both educational attainment and economic growth have focused on CTE policy. In 2005, the California State Board of Education adopted the *California Career Technical Education Model Curriculum Standards, Grades Seven Through Twelve.* In broader efforts around college and career readiness, California joined numerous other states in the adoption of Common Core State Standards in 2010. Further, California's new accountability framework, the California School Dashboard,[1] approved in 2016, includes the College Career Indicator.[2] The College/Career Indicator (CCI), one of six indicators included in the California School Dashboard, is calculated at the school-level by first placing individual students in one of three levels (*Prepared*, *Approaching Prepared*, or *Not Prepared).* Placement into levels is based on their 11th grade English language arts and math Smarter Balanced assessment scores, CTE pathway completion, AP and IB exam performance, dual enrollment, and A-G course completion. The inclusion of CTE pathway completion in the State's accountability system represents an important shift from solely traditional academic and assessment metrics to the inclusion of career technical education as a valuable part of postsecondary readiness.

Little is known about participation completion in CTE pathways across high schools in California since the recent efforts to improve college and career readiness have taken hold. In a

[1] The California School Dashboard was developed in response to the federally adopted Every Student Succeeds Act (ESSA) and national and California's new Local Control Funding Formula.

[2] The CCI is first calculated at the student level, where students are labeled as *Prepared*, *Approaching Prepared*, or *Not Prepared* based on their 11th grade ELA and Math SBAC scores, CTE Pathway Completion, AP and IB exams, Dual Enrollment, and A-G course completion. A school-level indicator is then determined by considering the proportion of students in the graduating cohort that earned a *Prepared* status. For example, schools with less than 10 percent of their graduating cohort earning *Prepared* receive a *Very Low* school-level indicator and schools with more than 70 percent of the graduating cohort receiving *Prepared* are considered *Very High* on the school-level indicator. For more detailed information on the College/Career Indicator (CCI) see the description and Technical Guide available from the CDE: https://www.cde.ca.gov/ta/ac/cm/cci.asp.

study utilizing course enrollment data for 2016-2017, the Public Policy Institute of California reports that nearly half (45%) of all California public high school students enroll in at least one CTE course (Bohn, Gao, & McConville, 2018).[3] Yet, the California Department of Education emphasizes the completion of CTE pathways, rather than single CTE courses, as an important measure of postsecondary readiness in the newly implemented California School Dashboard in 2016-2017.

This paper builds on the current knowledge by examining patterns of career technical education (CTE) pathway completion for California public high school students in two consecutive years and using multiple data sources on course-taking, student demographics, and school characteristics. Specifically, we will answer the following questions.

1) What are the most frequent CTE pathways completed by recent high school graduates?
2) Who completes CTE pathways and how does CTE pathway completion differ by key student characteristics (e.g. race/ethnicity, socioeconomic status, English Learner status, students with disabilities)?
3) How do CTE pathway completion rates differ by key school characteristics (e.g. type of school, location of school, diversity of student body, and concentration of socioeconomic disadvantaged students)?

Background

National Context for CTE

Amidst renewed interest by federal and state policy makers, CTE has a substantial presence in American public education. Nationwide, there are more than 8 million secondary students and nearly 4 million postsecondary students enrolled in career and technical education (CTE) programming and approximately $1.1 billion in federal investment, supplemented by substantial annual state investments. For example, California recently committed to an annual investment of over $200 million in community college based CTE degree programs (Bohn, Gao, & McConville, 2018), on top of the $500 million dollars, since 2013, in education funds devoted to expanding career pathway programs in grades nine through postsecondary schooling.

Newer policy and resource investments in CTE programs now align with research that has long recognized the potential benefits of diverse options for students in high school (Cullen, Levitt, Robertson, & Sadoff, 2013). Scholars and policymakers, relying on largely descriptive evidence, have highlighted that educational models such as early college high schools (Edmunds et al., 2012), career academies (Visher, Altuna, & Safran, 2013), and Linked Learning (Hubbard & McDonald, 2014) show promise as effective alternative models of secondary education relative to traditional comprehensive high schools. It is not surprising that states like

[3] See: http://www.ppic.org/publication/career-technical-education-in-california/ Note that this rate is substantially lower than what has been found in other states or calculated from nationally representative datasets.

Alabama, Arkansas, Virginia, Wisconsin and others have adopted graduation standards that encourage or require participation in CTE.

States look to CTE as a way to fill gaps in "middle skills" jobs (i.e. jobs requiring some postsecondary education, but not necessarily a four-year degree). Indeed, many high school programs and initiatives have integrated career-focused skills alongside rigorous academics, including career academies (Cellini, 2006; Visher, Altuna, & Safran 2013), early college high schools (Edmunds et al., 2012), and the Linked Learning model in California. Academic preparation for postsecondary education has also been facilitated through CTE pathways at community colleges through dual enrollment and dual credit opportunities (Community College Research Center [CCRC], 2012; Hughes, Rodriguez, Edwards, & Belfield, 2012).

Situated in this context of considerable investment and participation, it is crucial to understand both patterns of participation in CTE and how participation relates to subsequent outcomes.

Evidence for the Effectiveness of CTE

A substantial body of observational research has documented the potential impact of participating in CTE on both academic and labor-market outcomes, yet only a few studies can make causal claims about the impact of CTE participation (e.g. one true experiment, Kemple & Willner, 2008, and a few quasi-experiments, Dougherty, 2018; Hemelt & Lenard, 2018). Findings from observational studies demonstrate that students with CTE training in high school enjoy higher probabilities of employment and higher subsequent wages (Bishop & Mane, 2006; Meer, 2007; Neumark & Rothstein, 2006), as well as a broader set of educational engagement outcomes (Kelly & Price, 2009).

There is broad agreement on some elements of what constitutes a quality CTE program, though this definition has expanded somewhat in recent years. Most people agree that CTE participation should lead to higher wages, as participants in successful programs have learned skills associated with market value. Historically, there was less expectation around the relationship between CTE participation and improved academic outcomes, in part because CTE coursework often substituted for additional academic courses. Changes in the labor market and increased need for strong general learning skills have changed this notion. As a result, there is greater agreement now that CTE participation might also improve learning, high school completion, two-year college enrollment, and acquisition of certifications with value in the labor market. With that in mind, we briefly review what evidence exists, to date, on CTE effects and outcomes. The largest challenges in this literature include the fact that much of the data used no longer reflects prevailing policy contexts, outcomes are often only short-term, and relatively few studies can support interpretation as causal effects.

Effects on Employment. Overall, CTE participation appears to increase wages in the short term, though longer-term effects are more ambiguous. Descriptive work by Symonds, Schwartz, and Ferguson (2011) found that students who have access to a structured repertoire of skills and experiences that better prepare them for the labor market make smoother

transitions into the labor force after high school. There are also numerous studies, including one randomized experiment (Kemple & Willner, 2008; Page, 2012), that find that students who participate in a CTE program have higher earnings, on average, than similar students who attended a non-CTE program (Bishop & Mane, 2004, 2005; Kreisman & Stange, 2017; Mane, 1999; Meer, 2007; Neumark & Rothstein, 2006; Stern, Dayton, & Raby, 2010). In one high quality study using lifetime earnings from Germany and Austria, researchers found that initially higher wages were followed up by lower earnings throughout one's career (Hanushek, Woessman, & Zhang 2017). This evidence, however, uses older data from outside the United States, leading to a lack of clarity about generalizability.

Research on CTE participation in postsecondary settings largely focuses on labor market outcomes, and is limited in predicting degree attainment (Anderson et al., 2017; Bahr, 2016; Bettinger & Soliz, 2016; Hollenbeck & Huang, 2014; Jenkins, Zeidenberg, & Kienzl, 2009; Stevens, Kurlaender, & Grosz, 2018; Xu & Trimble, 2016). Research using data from the 1980s and 1990s suggested that associate's degree programs with an occupational focus were associated with higher earnings than academic associate's degrees (Bailey, Kienzl, & Marcotte, 2004). More recent work from the Center for Analysis of Postsecondary Education and Employment analyzed returns by specific occupational field and found substantial heterogeneity by fields; unsurprisingly, health occupations have the largest returns (Bailey & Belfield, 2017; Bettinger & Soliz, 2016; Stevens et al., 2018). Postsecondary CTE participation and employment gains also vary by race, ethnicity, and sex (Bahr, 2016; Bettinger & Soliz, 2016; Stevens et al., 2018).

Psycho-Social Benefits. Additional research has suggested that CTE participation may also provide non-monetary benefits. Research by Kelly and Price (2009) suggests that students derive positive psychological benefits, for example improvements in feelings of self-worth, from the success and engagement they experience while enrolled in CTE coursework, and that CTE programs may play a role in improving student efficacy along with educational and labor-market outcomes. Supporting this idea, other research has shown that feelings of efficacy and self-worth are important predictors of student success in school (Finn, 1989), and that many students enter high school with limited feelings of efficacy (Fredricks & Eccles, 2002). Because efficacy and self-worth influence a student's engagement in his or her learning environment, they could have an important effect on a student's decision to remain enrolled or drop out of school altogether (Agodini & Deke, 2004: Finn & Rock, 1997; Kelly & Price, 2009; Plank, DeLuca, & Estacion, 2008; Rumberger, 2011).

Educational Impacts. Despite evidence that CTE participation may promote positive financial and psychological outcomes, there is no consensus on its impact on educational outcomes such as test scores, high school graduation, or enrolling in postsecondary education. The lack of consensus reflects, at least partially, the understanding that participation in CTE is self-selected meaning that participants may not be comparable to non-participants in ways that might also show up in academic outcomes. The only large-scale randomized experiment to examine the effect of CTE participation comes from the MDRC evaluation (and subsequent reanalysis by Page, 2012) of Career Academies (Kemple & Willner, 2008). Though this

evaluation found important long-term income benefits for those randomly offered a place in a Career Academy, there were no resulting differences between the treatment and control groups in terms of high-school graduation or enrollment in post-secondary education.[4] A more recent analysis of a single Career Academy in North Carolina (Hemelt & Lenard, 2018) shows that winning a lottery and attending a Career Academy can boost high school graduation and initial enrollment in college, and that improved attendance at the start of high school may explain much of the graduation effects. Though this latter evaluation uses more recent data, the smaller scale and unusually high quality of the program they study makes it harder to generalize.

In addition to the work on Career Academies, there is emerging but limited high-quality evidence on positive educational outcomes—and high school graduation in particular—from other modes of CTE program delivery (Dougherty, 2018; Gottfried & Stratte Plasman, 2018). Descriptive research also suggests that taking more coursework in CTE, and being a CTE concentrator in particular, is associated with better rates of high school completion and transition to postsecondary education (Dougherty, 2016). The only evidence to-date related to participation in CTE-focused dual enrollment demonstrates gains in college enrollment, college grade point average, and college credit accumulation (CCRC, 2012). And newer work in Massachusetts and Connecticut suggests that CTE participation in high school may also lead to higher probabilities of enrolling immediately in college (Dougherty, Brunner, & Ross, 2018).

Theory of Change and Model Delivery

Whether we should expect studies of CTE to find effects on educational outcomes depends in part on what one assumes is the purpose of CTE. For instance, it is possible that all the benefits of participating in CTE could be examples of students being rewarded for gaining a specific set of skills valued in the labor force (specific human capital investments, see Becker, 2009; Lazear, 2009). It is also reasonable to believe that if CTE programs keep students in high school longer, then there is the potential that they also increase their general skill set (general human capital, see Becker, 1962; 2009), or that by earning diplomas these students benefit from a signal or credential (Clark & Martorell, 2014; Spence, 1973) that is also valued by employers (Murnane, Willett, & Tyler, 2000; Tyler, Willett, & Murnane, 2000).

The specific theory of change behind why CTE participation might improve outcomes likely varies by context. However, there is growing evidence that participating in CTE in high school provides a student with a unique model of instruction, with greater program choice, and mentoring, often over multiple years (Black, Grenard, Sussman, & Rohrbah, 2010; DuBois, et al, 2011). This, then may enhance their educational outcomes by first, providing clearer connections and pathways to a student's areas of interest. Specifically, evidence suggests that a more engaging high school environment leads to better attendance and discipline outcomes, and is associated with higher probabilities of completing high school. Second, a directed

[4] In this study, students in both the Career Academies and the traditional schools had high levels of high school completion and college attendance, and so any effects might have been difficult to detect.

pathway of study that is connected to labor market needs can improve students' postsecondary plans and increase employability (Bishop & Mane, 2004; Kemple & Willner, 2008). Better high school completion prospects, coupled with clearly articulated career training pathways aligned with local community colleges, may also increase the likelihood of post-secondary enrollment and degree completion.

Though CTE has been around throughout the history of American education, and funded partially by the federal government for over 100 years, the models for delivering CTE instruction have changed. Early instances of occupation-focused academies (e.g., in the Philadelphia school district; see Neubauer, 1986; Stern, 1992), as well as specialized CTE schools (Conant, 1959) focused on offering a broader range of CTE program choice and extensive exposure to training. More recently, these models have expanded and include new waves of career academies, Linked Learning models (started in California and now just beginning to proliferate in other states), and the formation of other specialized academies (see Jacoby & Dougherty, 2016; Visher & Stern, 2015, for examples). The evolution of delivery models also included a change in moniker. Nomenclature changed from *vocational education*, which was often viewed negatively given a legacy of tracking through the late 20th century, to *career and technical education*, and was first codified in the 2006 reauthorization of federal Carl D. Perkins Act.

As noted by Visher and Stern (2015), most CTE models include programs in comprehensive high schools or part-day programs in technical training centers (where students are bused from their comprehensive high school to the technical center midday). These programs, which offer only limited exposure to a CTE curriculum, may mask the potential benefits of larger-scale exposure to CTE. However, career academies, Linked Learning, and a handful of full-time regional technical schools do offer full-day programs where all students in the school concentrate in one of the 16 different nationally recognized career clusters (NASDCTE, http://www.careertech.org/). Visher and Stern (2015) note that these types of full-day programs are present in Massachusetts, but neglect to point out that similar full-day CTE programs also exist, to varying degrees, in Connecticut, New York, and New Jersey.

As CTE has evolved in its moniker and its place in mainstream educational policy, there has been a parallel growth in the fields of study that fall under the CTE umbrella. CTE is still the bastion of the construction trades like carpentry, electrical, and plumbing, but also now includes an expanded range of health services fields, advanced manufacturing, information technology, biotechnology, engineering, and environmental sciences (among others). The expansion of CTE to include fields that have clearer pathways to postsecondary training and degrees has meant that in some instances the students who are participating in CTE may have shifted as well. At a minimum, the inclusion of programs that have historically been more aligned with college going means that perceptions of CTE and what might be possible after participating in CTE are changing.

Patterns of Student Participation

Most studies that try to assess patterns of participation in CTE have used nationally representative samples such as NELS 1992, ELS 2002 or NLSY 1997, all of which are quite outdated (given the rapid change in the educational policy landscape over the last two decades), or used data from before the Perkins reauthorization in 2006 and subsequent movement towards the Career Cluster Framework (CCF). This may be particularly problematic given Giani's (2017) findings that participation in CTE shifted (at least in Texas) following the Perkins reauthorization and increased emphasis on postsecondary preparation. Specifically, since the -Perkins reauthorization, CTE participants were more likely to be white, for example. If an increase in rigor and changing perception about CTE has changed or is changing participation patterns, this deserves special attention. In contrast, using the NLSY 1997 cohort which is older but nationally representative, Kreisman and Stange (2017) found that males, students whose mother had only a high school degree, those who were low-income, received public assistance, or lived in the south or rural areas were all more likely to take more vocational classes than more educationally advantaged students. Vocational course-taking also tended to be lower, on average, among those who had scored higher on standardized tests of achievement. Thus, it is hard to know, *a priori*, whether one might expect CTE participation in California to follow more segregated patterns based on gender, race, or family income like in the past, or whether the evolving context of CTE to include programing like information technology and engineering might have pushed participation patterns in another direction.

Legacy of Tracking

Historically, CTE had been seen at least partially as an academic outlet for lower-achieving or unmotivated students (Fraser, 2008; Gamoran & Mare, 1989; Kelly & Price, 2009). Moreover, persistent patterns of racial discrimination and unequal educational opportunities in U.S. schools resulted in troubling curricular tracking patterns. Despite federal legislation in the 1960s (e.g. desegregation, Title 1 of the Elementary and Secondary Education Act), aimed at addressing the legacy of racial and socioeconomic segregation in the first half of the 20th century, there was substantial evidence of negative tracking through the 1980s. Work from Oakes (1983) demonstrated that access to specific forms of vocational curricula (e.g. business versus building trades) differed systematically based on the racial composition of schools (predominantly White schools had more of the former, predominantly minority schools had more of the latter). Oakes' findings mirrored earlier findings regarding differences by race and gender in the access to CTE (Anderson, 1988; Clifford, 1982). This earlier work heightened the saliency of educational tracking more generally (Gamoran & Mare, 1989; Oakes & Guiton, 1995), as well as efforts to maintain a focus on CTE while reducing such bias in access (e.g. the School to Work Opportunities Act of 1994).

California CTE Landscape

Over the past two decades, California has made substantial policy and resource investments in CTE. In particular, Senate Bill 70 in 2005 allocated $20 million to CTE at the K-12

and community college level (the bill was reauthorized as SB 1070 in 2012). In addition to funding, the Legislature addressed the goals and scope of CTE. For example, legislation through Assembly Bill 2648, passed in 2008, defined the notion of a CTE pathway, "A multiyear, comprehensive high school program of integrated academic and technical study that is organized around a broad theme, interest area, or industry sector, including, but not necessarily limited to, the industry sectors identified in the model standards adopted by the state board," and articulated instructional goals including, "project-based learning and other engaging instructional strategies that intentionally bring real-world context and relevance to the curriculum where broad themes, interest areas, and CTE are emphasized." Other legislation (Assembly Bill 790) in 2011 authorized a Linked Learning Pilot Program[5] and awarded $2 million in competitive grants to school districts for implementation of Linked Learning and technical assistance with the model. Additional legislation (Assembly Bill 790 also signed into law in 2011) authorized a CTE alternative graduation requirement (to substitute the arts and foreign language requirement) starting in the 2012-2013 school year. The stated purpose of the legislation was to "have more equitable opportunities to learn skills needed for entry into the workforce, to pursue postsecondary educational goals, and to contribute to the social cohesion of the state."[6]

More recently, Assembly Bill 86 was signed into law, creating the California Career Pathways Trust (CCPT), and providing, initially $250 million, and ultimately, $500 million, in funds for CTE programs. These competitive state grants were made available to school districts, county superintendents of schools, charter schools, and community colleges to establish new or expand existing career pathway programs in grades nine through fourteen (community college).[7] The intended goals of the CCPT are to prepare students for "high-skill, high-wage jobs in emerging and growing industry sectors in the local or regional economy through a sequenced, career-relevant curriculum following industry-themed pathways," (California Department of Education, 2017).[8] To date, there is very limited evidence on the impact of these efforts in the state. Moreover, the state—at present—is constrained in obtaining strong evidence on impacts due to data limitations between and across education and employment segments. Other states have begun to break down these barriers in order to rigorously evaluate their CTE programs, for example Michigan, Tennessee, Arkansas and Massachusetts, among others.

Need for Updated CTE Research

Over the past several decades, as more states look to better prepare students for the changing demands of the labor market, policymakers and educators look to career technical education with promise. However, the current state of CTE research does not fully reflect the evolution of CTE policy and practice in terms of meeting workforce demand, or as a strategy to

[5] Linked Learning is a program that was developed in California with a focus on the notion that students will work harder and learn more if they can see the relevance of the skills and materials they are learning.
[6] Assembly Bill 1330
[7] https://www.cde.ca.gov/ci/ct/pt/
[8] http://www.cde.ca.gov/re/lr/lr/ap/

actively engage students in experiential learning. Moreover, there is a critical need to examine CTE as a means for increasing economic opportunity, specifically for disadvantaged populations (e.g. low-income, English learners, adults without high school diplomas). To date, the majority of research has not captured the changing context of CTE described above. The main concern with much of the descriptive literature is the difficulty in comparing students in CTE pathways to those who are not. Understanding the many reasons students sort into different educational pathways plagues much of education research. Disentangling individual choice, motivations, prior achievement, from access, school structures, selection processes, etc. makes it difficult to determine whether one program (over another) yields positive outcomes for similar students. Nevertheless, many school systems, including California public schools, invest heavily in CTE pathways, and as such should consider closely how this important educational pathway may be distributed across the state's school systems and the students they serve.

With an increasing emphasis on CTE as a lever to advance educational and labor market outcomes, the perpetually evolving school environments in which CTE programs are delivered, and the diversifying fields and industries included under the CTE umbrella, it is important now more than ever to seek a comprehensive understanding of students' CTE course-taking behavior. In this paper we take a step in that direction by examining both participation in and completion of articulated CTE pathways for a cohort of California high school graduates. Specifically, we identify the most frequent CTE pathways completed by California high school graduates and examine how CTE pathway completion differs by key student characteristics (e.g. race/ethnicity, socioeconomic status, English learner status, or for students with disabilities). We also explore how CTE pathway completion rates differ by key school characteristics (e.g. type of school, location of school, diversity of student body, and concentration of socioeconomic disadvantaged students).

Data and Methods

Data and Sample

To examine patterns of career technical education (CTE) pathway participation and completion for California public high school students, we use data provided by the California Department of Education under a broader partnership agreement.[9] Our analysis combines multiple datasets extracted from the California Longitudinal Pupil Achievement Data System (CALPADS),[10] and includes student-level participation and completion data in articulated CTE pathways, as well as student demographic data (e.g. gender, race/ethnicity, socioeconomic status, English Learner status, high school of attendance). Our primary analytic sample includes

[9] UC Davis School of Education researchers have an IES partnership grant to more broadly examine California K-12 and postsecondary alignment, and the move to Common Core State Standards as a part of college and career readiness reform efforts.

[10] California Longitudinal Pupil Achievement Data System (CALPADS) is California Department of Education's longitudinal data system. Launched in 2009, CALPADS includes student-leve1 data elements related to student enrollment, demographics, program participation, course enrollment and completion, discipline, and assessment. Although there are substantial data quality issues in CALPADS, the data improve in quality in recent years. For more information, see: https://www.cde.ca.gov/ds/sp/cl/background.asp

the cohort of students who entered a California public high school in 2012-2013 and were expected to graduate in 2015-2016 (N = 486,126); in 2015-2016 these students were attending approximately 2,900 California public high schools.[11]

CTE Pathways

As adopted in 2005, the *California Career Technical Education Model Curriculum Standards, Grades Seven Through Twelve*, outlines 58 CTE pathways in 15 industry sectors (California Department of Education, 2007), as does the more recent *Career Technical Course Code Definitions by Sector and Pathways 2015-16 User Guide.* Over the last decade, the CTE pathways and industry sectors have shifted somewhat to accommodate advancing technology and changing demands of industry. In the CTE data we examined, there are a total of 74 CTE pathways within the 15 industry sectors.[12] For simplicity, we present our findings in this narrative using the 15 industry sectors. We then provide more detailed results by the 74 pathways in the appendix. Table A.1 in the Appendix provides a crosswalk of CDE's 15 industry sectors and the 74 pathways.

High school students in California participate in CTE coursework at varying levels. Some students may enroll in a single CTE course, aligned to an area of personal interest or to satisfy elective course requirements. Other students may elect to focus part of their high school studies in one of the articulated CTE pathways, which consists of a pre-determined sequence of two or more courses, depending on the particular pathway, and a capstone course. Students who take more than one course in a pathway, but who do not successfully complete all required courses, including the capstone course, are defined as pathway concentrators. CTE Pathway Completers are those students who complete all coursework, including the capstone course, with a grade of C or better. In our analysis we focus on CTE Pathway concentrators and completers, rather than single course-takers, in part due to data limitations and in part due to the importance of CTE pathway completion as an important metric. CTE completers are considered career ready, an important component of the College/Career Indicator in the state's new accountability system. Moreover, CTE pathway completion—versus singular course enrollment—is widely recognized as critical to reap the educational and labor market reward and is a metric used for federal funding.

Data Analysis

In our investigation we look both at student-level characteristics and school-level characteristics in order to understand who is participating in and successfully completing CTE pathways and which schools may be best supporting students in this endeavor. These analyses

[11] The dataset provided by California Department of Education includes 2907 unique schools in 2015-2016. These schools include traditional high schools, as well as charter, continuation, alternative, community day, special education, ROP and opportunity schools.

[12] There are 16 different nationally recognized career clusters (NASDCTE, http://www.careertech.org/). California combines *Human Services* and *Education and Training* from the 16 national clusters, resulting in 15 industry sectors in California.

are entirely descriptive in nature; observed differences in student characteristics or school characteristics should not be interpreted as predictive or causal.

Student-level analysis. We first examine the characteristics of students who participate in and complete CTE pathways during high school, specifically looking at how characteristics among these students may differ from students not participating in CTE pathways. We then look at the distribution of CTE students across industry sectors, noting industries with the highest numbers of completers. Finally, we examine the differences in student characteristics within industry sectors, highlighting notable differences in CTE pathway completion by gender, race/ethnicity, academic achievement levels (as measured by the Smarter Balanced Assessments), socioeconomic status, English Learner status and for students with disabilities.

School-level analysis. We also investigate differences in the schools where CTE concentrators and completers are enrolled. Students who concentrate in and complete CTE pathways are distributed across about half (56%) of the 2,900 public high schools that enroll students in the 2015-2016 cohort, which include the many alternative schools serving special groups of students (i.e. students with profound disabilities and adjudicated youth). However, 91% of all CTE concentrators and completers attend traditional public schools (n = 1,588). Therefore limit our analysis of school characteristics to traditional public schools. In this analysis, we pay particular attention to the differences between schools with large proportions of CTE pathway completers, compared to those where few (or no) students completing CTE pathways.

Findings

Characteristics of CTE Pathway Concentrators and Completers

Nearly 18% of students in the 2015-2016 cohort completed at least one CTE pathway prior to graduation (CTE Completers), while another 19% participated in a CTE pathway without successfully completing the entire articulated course sequence (CTE Concentrators). There are some small, but notable differences in observable characteristics between students concentrating in and completing CTE pathways compared to students who are not participating in CTE pathways (non-CTE students). Aligned with findings from several other studies including, a nationally representative sample (Kreisman & Stange, 2017)), as well as studies of more recent cohorts in Massachusetts (Dougherty, 2018) and Arkansas (Dougherty, 2016), CTE students in California are more likely to be male and from socioeconomically disadvantaged backgrounds than students who do not participate in CTE. Amongst students in CTE pathways, there are also slightly higher proportions of English language learners than amongst non-CTE students. There are also observable differences by racial/ethnic background; students participating in and completing CTE pathways were more likely to be Latino and less likely to be Asian, African American, or White than non-CTE students. When considering academic performance, there is little difference between CTE students and non-CTE students in the average scores on the Smarter Balanced Assessments.

Table 1: Student Characteristics of CTE Pathway Concentrators and Completers

	Non CTE Students	CTE Concentrators	CTE Completers
	n = 308,121	n = 92,849	n = 85,156
Male	49%	54%	53%
African American	7%	6%	5%
Asian	13%	10%	12%
Latino	49%	56%	54%
Other	3%	3%	3%
White	27%	25%	26%
Average SBAC ELA Score	2598	2583	2592
	Standard Met	Standard Met	Standard Met
Average SBAC Math Score	2569	2548	2560
	Standard Nearly Met	Standard Nearly Met	Standard Nearly Met
Socioeconomically Disadvantaged	55%	60%	59%
Students with Disabilities	9%	10%	9%
English Learners	13%	15%	14%

CTE Pathway Concentration and Completion by Industry Sector

For the approximately 37% of high school students who participate in or complete CTE pathways, the areas of career readiness and specialization vary. As indicated in Table 2, the most common industry sector for successful CTE pathway completion is *Arts, Media and Entertainment*, accounting for more than 19% of all completed pathways. The *Agriculture and Natural Resources*; *Health Science and Medical Technology*; *Hospitality, Tourism, and Recreation;* and *Information and Communication Technology* industries together account for 40% of CTE pathway completions, with between 7% and 11% of pathway completions in each of the four sectors. (Table A.1 in the Appendix provides a summary of student participation across the 74 CTE pathways.)

Table 2: Rates of CTE Pathway Concentration and Completion by Industry Sector

	CTE Concentrators	CTE Completers
	n = 92,849	n = 85,156
Agriculture and Natural Resources	11.8%	11.6%
Arts, Media, and Entertainment	22.1%	19.3%
Building and Construction Trades	4.2%	4.3%
Business and Finance	9.2%	6.7%
Education, Child Development, and Family Services	4.3%	5.4%
Energy, Environment, and Utilities	0.7%	0.9%
Engineering and Architecture	5.1%	5.7%
Fashion and Interior Design	1.0%	1.1%
Health Science and Medical Technology	7.0%	11.7%
Hospitality, Tourism, and Recreation	8.2%	9.4%
Information and Communication Technology	9.4%	7.1%
Manufacturing and Product Development	4.8%	3.3%
Marketing, Sales, and Services	5.3%	4.0%
Public Services	3.3%	4.5%
Transportation	3.6%	4.8%

Nearly 20% of those who complete a CTE pathway successfully finish multiple pathways and another 25% of CTE completers participate in multiple pathways; in other words, almost half of all CTE completers take coursework in more than one pathway. For the CTE students concentrating in and completing multiple pathways, there are distinct patterns in their participation. For instance, students focused on *Agriculture and Natural Resources* are the most likely to participate in a second pathway, and that second pathway is most often in the same industry. In contrast, students completing pathways in *Fashion and Design*; *Information and Communication Technology; or Marketing, Sales, and Services* are more likely to complete additional CTE pathways in the sectors of *Arts, Media, and Entertainment* or *Business and Finance*. There is also significant overlap between *Engineering and Architecture* and *Manufacturing and Product Development*.

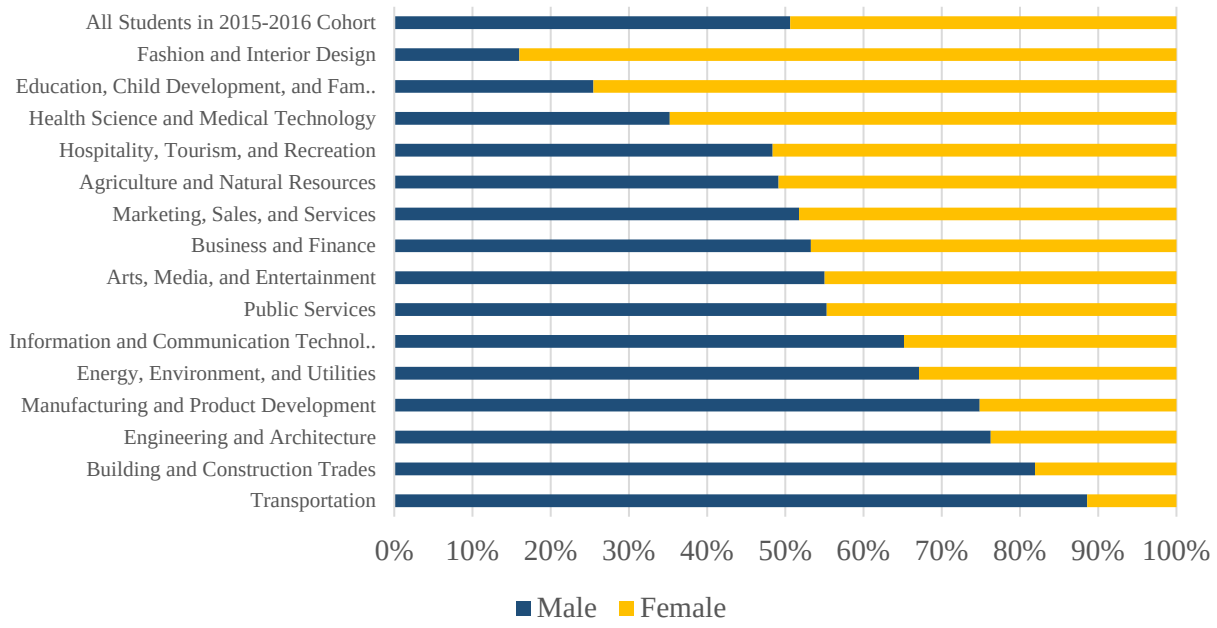
The distribution of CTE concentrators and completers across industry sectors may be driven by a number of factors. Student choice and course availability are essential components of CTE pathway participation and completion. The utility of a pathway may also be of particular importance; as students prepare to enter specialized fields, employment opportunities and expected earnings could influence pathway selection. Although explaining the mechanisms for student selection into CTE pathways is beyond the scope of this project, a few patterns are noteworthy given the broader employment patterns in California. For example, *Arts, Media and Entertainment* has the greatest student participation and completion rates of the 15

industry sectors, yet the *Business and Finance* field, with one-third as many high school CTE pathway completers, employed twice as many people in California in 2012 and is projected to have greater industry growth (Centers of Excellence, 2012). Similarly, the *Marketing, Sales and Services* and the *Education, Child Development and Family Services* sectors each account for about 5% of the CTE completers but *Marketing, Sales and Services* employs three times as many people as the *Arts, Media and Entertainment* sector and *Education, Child Development and Family Services* has 50% more jobs, and both fields anticipate much greater future demand (Centers of Excellence, 2012).

Characteristics of CTE Pathway Completers, by Industry Sector

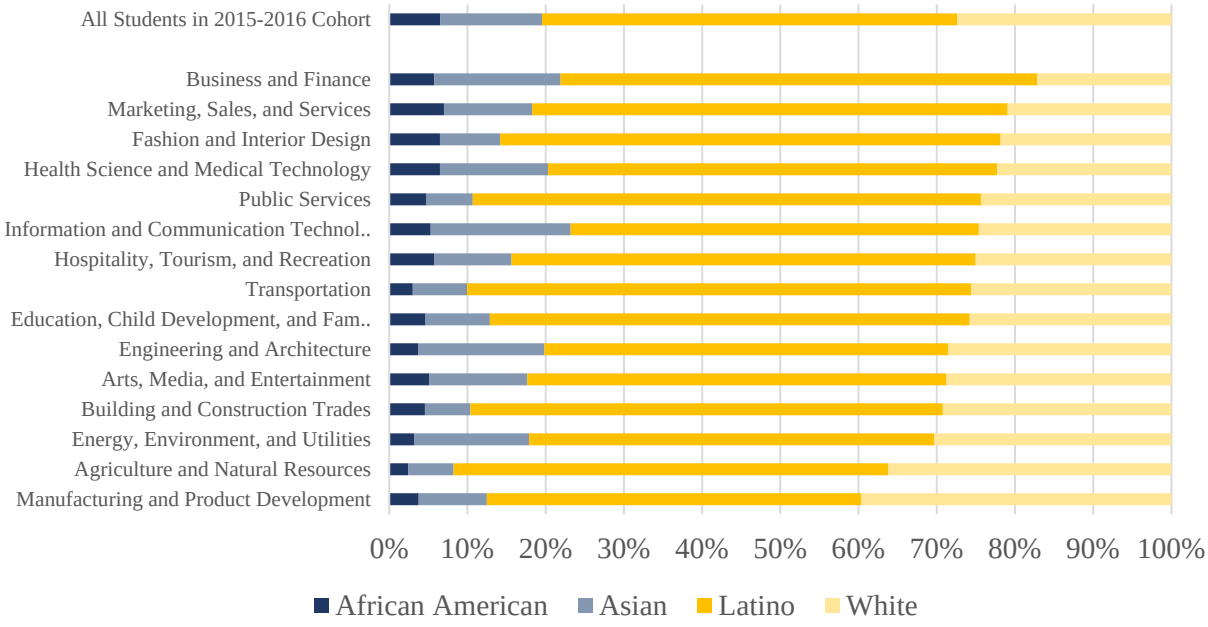
In addition to the differences in student characteristics between CTE pathway concentrators and CTE completers compared to non-CTE participating students, there are remarkable differences in student characteristics when considering the 15 industry sectors. Most notably, there are large differences in the proportion of males and females completing pathways across industry sectors. Figure 1 depicts CTE completers in each pathway by student gender. Male students complete CTE pathways at significantly higher rates than females in *Transportation; Building and Construction Trades*; *Engineering and Architecture*; *Manufacturing and Product Development; Energy, Environment, and Utilities;* and *Information and Communication Technology*. Conversely, female CTE pathway completers are disproportionately represented in the *Education, Child Development and Family Services*; *Health Science and Medical Technology;* and *Fashion and Interior Design* industries. (Table A.2 in the Appendix provides a summary of student characteristics for each of the 74 CTE pathways.)

Figure 1. CTE Pathway Completers, by Industry Sector and Gender



Across industry sectors, differences in student CTE pathway completion are also observed by student race/ethnicity, as depicted in Figure 2. In particular, Latino students are disproportionately represented in more than half of the industry sectors -- accounting for 63% of CTE completers in *Public Services; Transportation;* and *Fashion and Interior Design;* 60% in *Business and Finance;* and 598% of CTE completers in *Education, Child Development, and Family Services*; *Marketing, Sales and Services; Building and Construction Trades*; and 58% of completers in *Hospitality, Tourism, and Recreation* -- compared to their share of the cohort population (51%). Similarly, White students are disproportionately represented in *Manufacturing and Product Development* (38%) and *Agriculture and Natural Resources (35%)*, compared to their 26% share of the total cohort. Asian students are overrepresented in the *Information and Communication Technology*; *Engineering and Architecture*; *Business and Finance;* and *Energy, Environment and Utilities* sectors and largely underrepresented in *Agriculture and Natural Resources; Building and Construction Trades*; and *Public Services* sectors. (Table A.2 in the Appendix provides a summary of student characteristics for each of the 74 CTE pathways.)

Figure 2. CTE Pathway Completers, by Industry Sector and Student Race/Ethnicity



We also observe differences in the average student performance on the Smarter Balanced Assessments across industry sectors, despite the fact that, on average, CTE concentrators and CTE completers perform similarly to non-CTE students (see Table 1). Figures 3 and 4 illustrate differences in average student performance on the English Languages Arts (ELA) and Mathematics Smarter Balanced Assessments, respectively. Students who complete CTE pathways in *Engineering and Architecture*; *Health Science and Medical Technology;; Energy, Environment and Utilities; Arts, Media and Entertainment; and Information and Communication Technology* perform similarly or slightly better on both the ELA and math assessments than the

cohort average. In contrast, students completing CTE pathways in *Transportation*; *Building and Construction Trades*; *Fashion and Interior Design;* and *Hospitality, Tourism and Recreation* achieve lower scores on both assessments than the cohort average. In the remaining industry sectors, CTE completers perform near the cohort average on the assessments. Collectively, this evidences dispels any myths that CTE programs serve students with lower academic ability. In fact in a number of the more technical fields, CTE students outperform their non-CTE peers. Yet, even in those fields where academic performance is lower than the cohort average, this descriptive evidence only illuminates differences most likely driven by student selection rather than program quality.

Figure 3. CTE Pathway Completers, by Industry Sector and Academic Performance in ELA

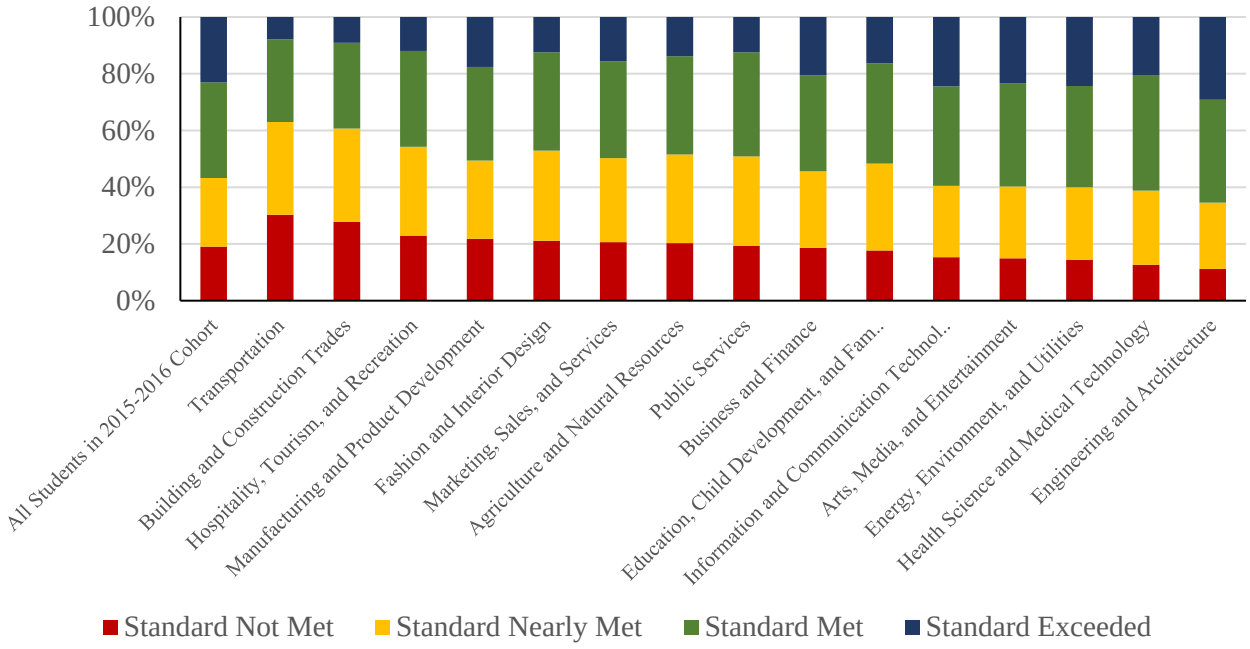
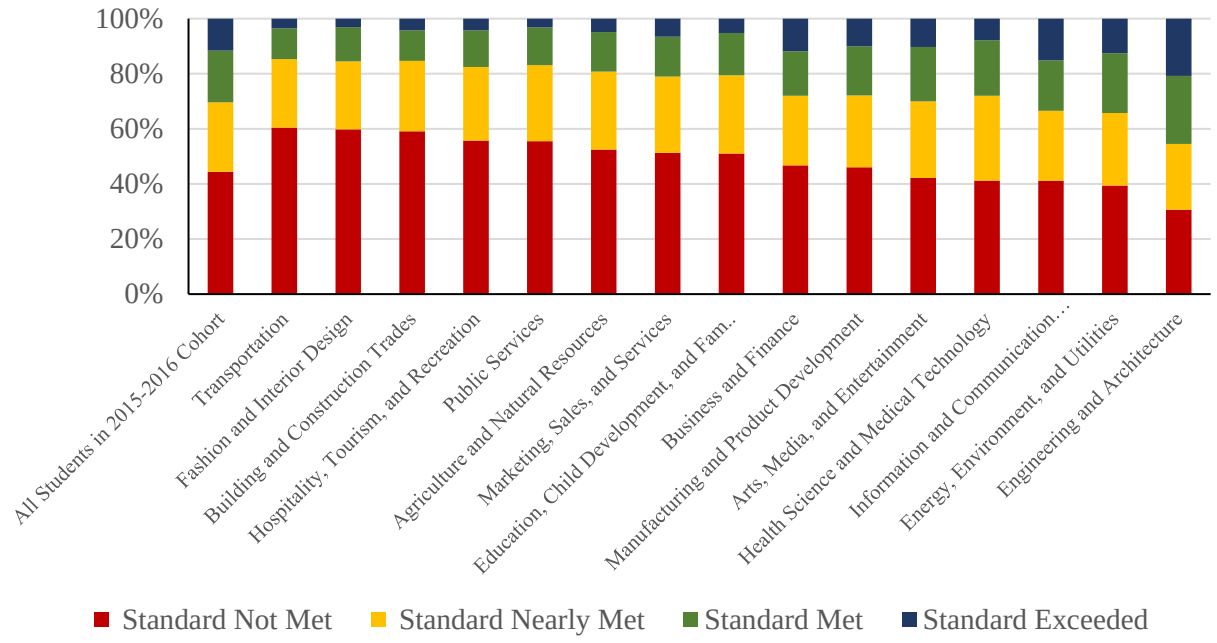


Figure 4. CTE Pathway Completers, by Industry Sector and Academic Performance in Math



Differences in the proportion socioeconomically disadvantaged students, English Learners, and students with disabilities who complete CTE pathways across industry sectors are also present (Figures 5 – 7). The proportion of students from socioeconomically disadvantaged backgrounds within industry sectors ranges from 52% in *Manufacturing and Product Development* to 66% in the *Fashion and Interior Design* and *Transportation* sectors, compared to 57% of SED total students in the 2015-2016 cohort (Figure 5). Likewise, the rate of CTE completers classified as English Learners varies across industry sectors (Figure 6), with a range of ten percentage points and an overall cohort rate of 13%. There are twice as many English Learners in the *Transportation* sector (20%) than in *Engineering and Architecture* (10%). Finally, the proportion of CTE completers who have disabilities varies across industry sectors somewhat. While 9% of the cohort students have disabilities, only 5% of CTE completers specializing in *Health Science and Medical Technology* have disabilities and 6% of those in *Engineering and Architecture*. In contrast, 14% of CTE completers in the *Transportation* sector have disabilities. (Table A.2 in the Appendix provides a summary of student characteristics for each of the 74 CTE pathways.)

Figure 5. Socioeconomically Disadvantaged CTE Completers, by Industry Sector

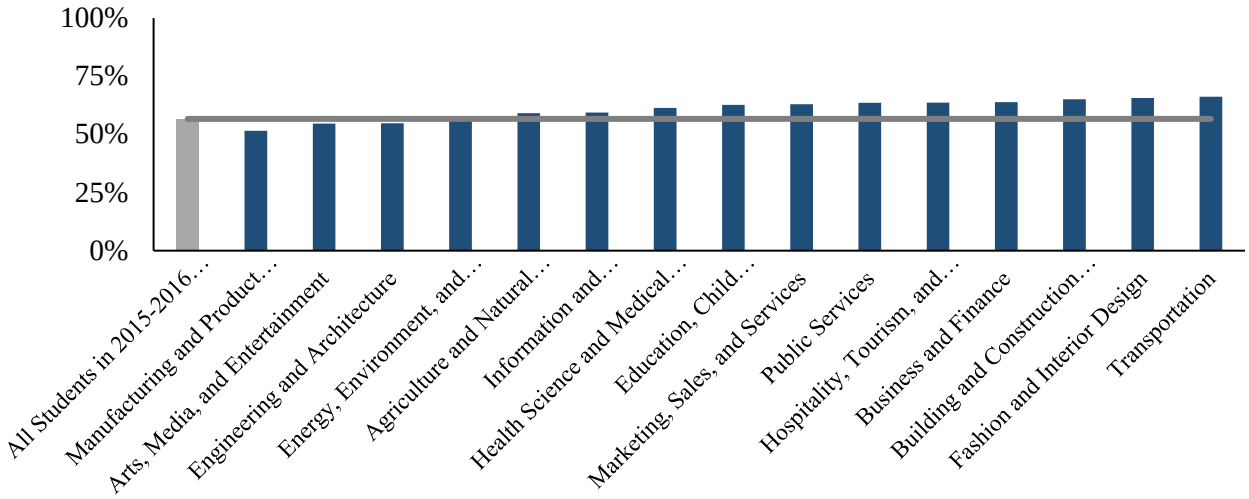


Figure 6. English Language Learning Completers, by Industry Sector

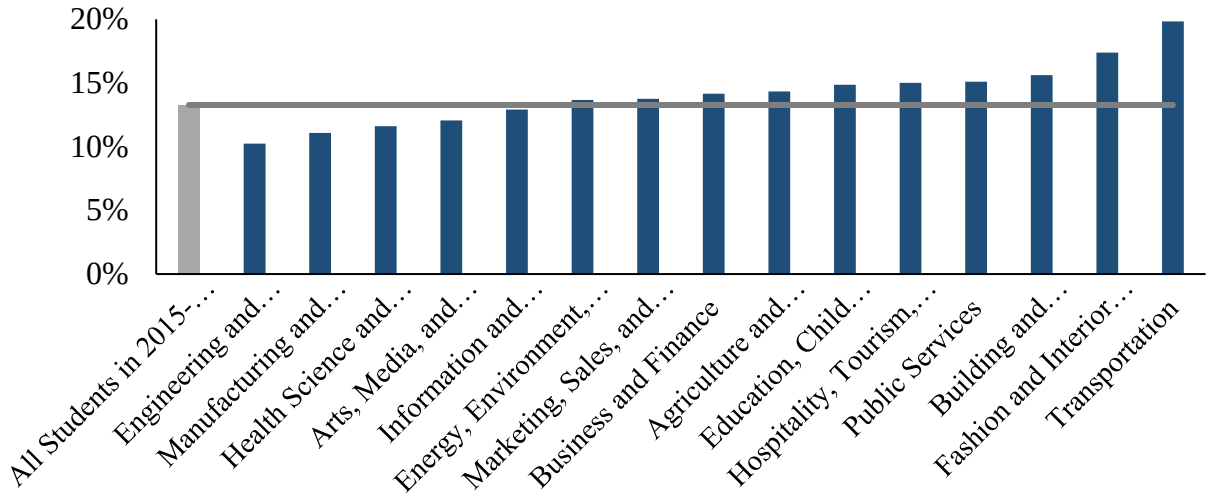
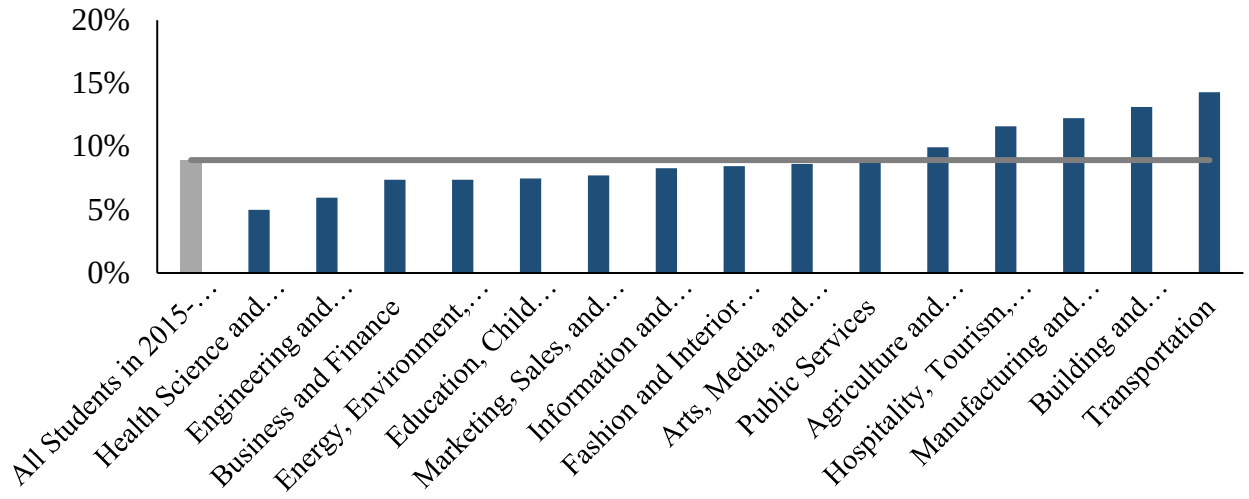


Figure 7. Students with Disabilities who Complete CTE Pathways, by Industry Sector

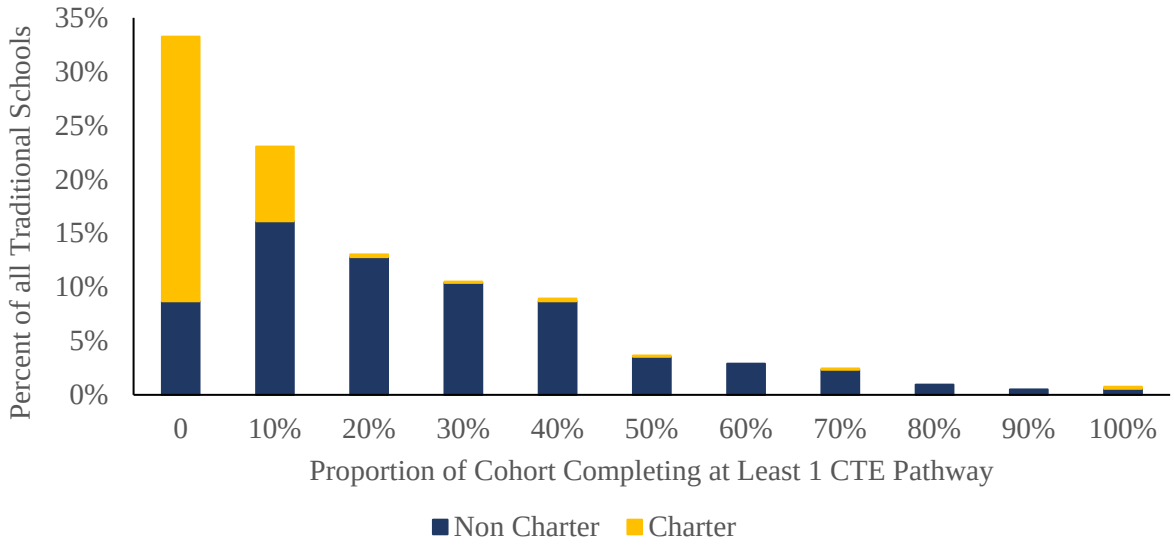


Characteristics of Schools Attended by CTE Pathway Completers

As students self-select into CTE courses, choice is inherent to any completion; however, the choices available to students may be limited by the high school a student attends. Thus, in the absence of CTE course offering data, it is important to examine the characteristics of schools where students concentrate in and complete CTE pathways. The majority of students who concentrate in and complete CTE pathways (91%) are distributed across 67% of the state's traditional public high schools (n= 1,588).[13] Of the 33% of schools with no CTE students, most are charter schools, as depicted by the yellow bars in Figure 8. This suggests that students enrolled in traditional high schools operated by public school districts have access to CTE programming, with few exceptions. Yet, in these schools with CTE completers, the vast majority have only a small proportion of the student body completing CTE pathways. Simply put, about 150 high schools in California have more than 50% of the 2015-2016 graduating class completing CTE pathways, and only 22 schools have 100% of their graduates completing CTE pathways. Figure 8 depicts the distribution of CTE pathway completers within California's traditional public schools, including charter schools and district-operated schools.

[13] The remaining 9% of students who concentrate in or complete CTE pathways attend one of the approximately 1300 alternative schools operated by districts and County Offices of Education across California. Alternative schools are defined by California Department as previously described.

Figure 8. Schools Serving Varying Proportions of CTE Pathway Completers



Additionally, we observe differences in the size of the average graduating cohort between schools serving various concentrations of CTE Completers. Schools with no CTE completers are serving much smaller cohorts of students than schools with any CTE pathway completers; this difference is not surprising given that over three-quarters of the schools with no CTE completers are charter schools and charter schools in California generally serve fewer students that district-operated high schools (Reed & Rose, 2018). Interestingly, however, amongst schools with any CTE completers, schools with larger proportions of students completing a CTE pathway have smaller cohorts, on average, than schools with lower rates of CTE completion.

Table 3. Characteristics of Traditional Schools, by Varying Rates of CTE Pathway Completers

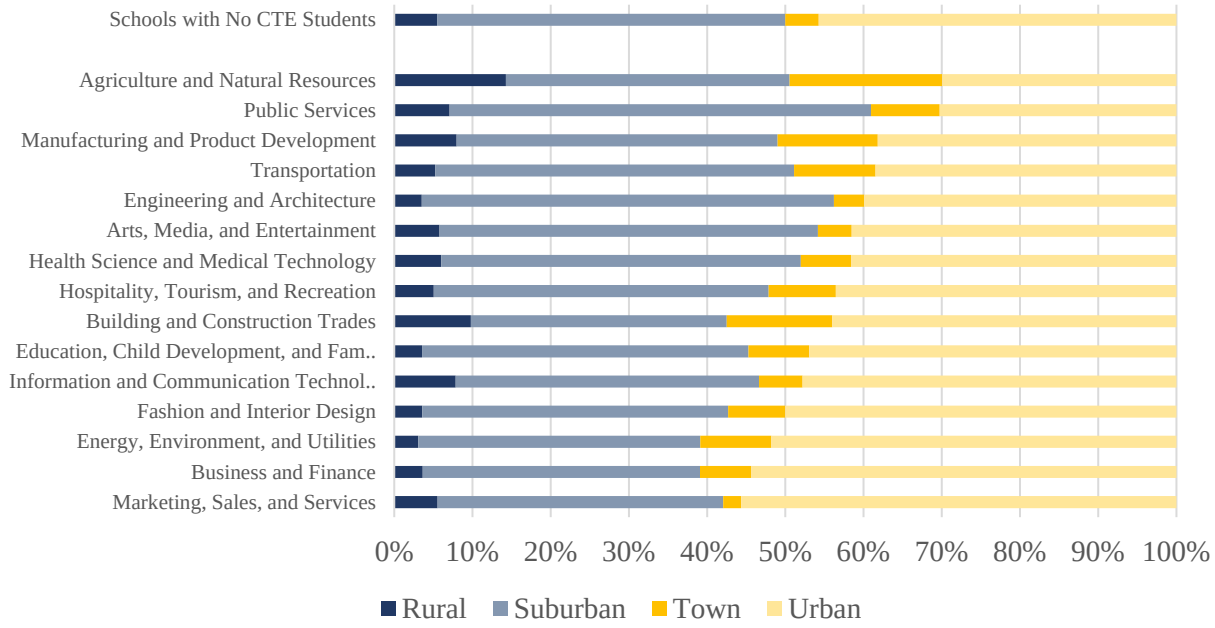
	No CTE Students	1% - 50% CTE Completers	51% - 75% CTE Completers	> 75% CTE Completers
	n= 454	**n=629**	**n=306**	**n=194**
Male	47%	51%	51%	51%
Socioeconomically Disadvantaged	61%	52%	57%	68%
Students with Disabilities	7%	9%	9%	9%
English Learners	12%	12%	14%	15%
Asian	10%	15%	11%	11%
African American	8%	7%	4%	6%
Latino	54%	46%	54%	61%
Other	3%	3%	3%	2%
White	25%	28%	28%	19%
Avg. SBAC ELA Scale Score	2597	2600	2600	2580
Avg. SBAC Math Scale Score	2559	2572	2570	2546
Rural	7%	5%	7%	8%
Suburban	35%	48%	50%	33%
Town	4%	3%	8%	11%
Urban	55%	44%	35%	48%
Average Cohort Size	230	519	487	397

We note further differences in schools with varying rates of CTE completion. Notably, as the rate of CTE pathway completion within a school increases so does the proportion of socioeconomically disadvantaged students, English learners, and Latino students; not surprisingly the concentration of socioeconomically disadvantaged students is highly correlated with student race/ethnicity and English learner status in California. Finally, the average performance on the Smarter Balanced Assessments in English language arts and mathematics decreases as the concentration of CTE completers increases. For schools with the highest concentrations of CTE completers (more than 75%), average performance in English language arts is within the Standard Nearly Met level, whereas for schools with fewer CTE completers the average performance is within the Standard Met level. This may be evidence of a focus on career readiness, rather than academic (or college) preparedness, for schools where most students complete a CTE pathway, or it may simply be evidence of student selection into schools with CTE programs.

Finally, the characteristics of schools attended by CTE completers may be somewhat related to industry sectors. While the locale of schools (urban, suburban, rural) with varying proportions of CTE completers does not differ systematically from the distribution of schools across this geographically diverse state, the location of schools does differ when considering

industry sector. For example, students completing CTE pathways in *Agriculture in Natural Resources* and *Building and Construction Trades* disproportionately attend rural schools and students completing CTE pathways in *Public Services* and *Engineering and Architecture* disproportionately attend suburban schools. Figure 9 displays the distribution of CTE pathway completers by industry and geographic location of the school.

Figure 9. CTE Completers, by Industry Sector and School Locale



Conclusion

In California, there are important lessons to be drawn from these observed patterns and differences in the participation of students in CTE pathways. For instance, there are clear gaps in the proportion of students completing CTE pathways within schools. The fact that access to Federal funds for CTE is allocated in proportion to CTE completers in prior years suggests that in some schools there is not sufficient incentive from these funding streams to encourage schools to produce completers. In contrast, other schools have larger shares of students who complete at least on CTE pathway. Differences in the gender, race/ethnicity, and socioeconomic status of students who complete CTE programs are noteworthy. Findings suggest that there may be clear differences in access or demand that must be better understood, and could also connect to funding incentives. For example, if lower-income Latino students participate in CTE at higher than average levels, but have more limited access to a breadth of pathways, the CTE policy landscape may hinder economic mobility rather the promote it. Furthermore, the gender-specific patterns of participation by sector also suggest that disrupting such patterns may be a policy lever that could be used to improve female representation in STEM fields if done properly. Of course, such ruminations are somewhat speculative and highlight the extent to

which it is crucial to better understand patterns of participation in CTE, as well as how this participation relates to subsequent outcomes.

To better provide access to high quality CTE programs subsequent analysis should be focused on geographic, or demographic, subsets of the state, with comparisons made between actual program offerings and completion. Furthermore, these analyses should unpack demonstrated labor market demand (and areas of growing demand), and whether existing program offerings and participation align with this demand (and growth) as well as the associated expected earnings. Furthermore, within areas where program offerings and participation are found to align with the local labor markets, increased emphasis can be placed on understanding differences in the patterns of access by student characteristics. For instance, more can likely be done to promote more equitable participation in STEM and college-aligned pathways by gender, race/ethnicity, and socioeconomic status.

These data and related interpretations provide a strong foundation from which to build when making statewide and local CTE policy decisions. As the accountability system is further implemented and subsequently revised, it there will be opportunities to tweak metrics related to career readiness such that labor market alignment of offerings and equitable access and participation are emphasized.

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Appendix

Table A.1. Industry Sectors, CTE Pathways and Share of CTE Completions by Pathway

Industry Sector	CTE Pathway Name	CTE Pathway Code	Pathway Completions
Agriculture and Natural Resources	Agricultural Business	100	1%
Agriculture and Natural Resources	Agricultural Mechanics	101	2%
Agriculture and Natural Resources	Agriscience	102	3%
Agriculture and Natural Resources	Animal Science	103	2%
Agriculture and Natural Resources	Forestry and Natural Resources	104	0%
Agriculture and Natural Resources	Ornamental Horticulture	105	3%
Agriculture and Natural Resources	Plant and Soil Science	106	0%
Arts, Media, and Entertainment	Design and Media Arts	111	12%
Arts, Media, and Entertainment	Game Design and Integration	114	0%
Arts, Media, and Entertainment	Performing Arts	112	2%
Arts, Media, and Entertainment	Production and Managerial Arts	113	5%
Building and Construction Trades	Cabinetmaking and Woodworking	120	2%
Building and Construction Trades	Engineering and Heavy Construction	121	0%
Building and Construction Trades	Mechanical Systems Installation and R..	122	0%
Building and Construction Trades	Residential and Commercial Construction	123	2%
Business and Finance	Business Management	182	5%
Business and Finance	Financial Services	180	2%
Business and Finance	International Business	181	0%
Education, Child Development, and Family Services	Child Development	130	3%
Education, Child Development, and Family Services	Consumer Services	131	1%
Education, Child Development, and Family Services	Education	132	2%
Education, Child Development, and Family Services	Family and Human Services	133	0%
Energy, Environment, and Utilities	Electromechanical Installation and Ma..	140	0%
Energy, Environment, and Utilities	Energy and Power Technology	143	0%
Energy, Environment, and Utilities	Environmental Resources	141	0%
Energy, Environment, and Utilities	Telecommunications	142	0%
Engineering and Architecture	Architectural Design	150	2%
Engineering and Architecture	Engineering Design	152	2%
Engineering and Architecture	Engineering Technology	153	1%
Engineering and Architecture	Environmental Engineering	154	0%
Fashion and Interior Design	Fashion and Merchandising	160	1%
Fashion and Interior Design	Interior Design	161	0%
Fashion and Interior Design	Personal Services	162	0%
Health Science and Medical Technology	Biotechnology	196	1%
Health Science and Medical Technology	Biotechnology Research and Development	190	0%
Health Science and Medical Technology	Diagnostic Services	191	0%

Note: This table includes 74 CTE Pathways included in data obtained from California Department of Education. Not all pathways were present in every year.

Table A.1 (continued). CTE Pathways and Industry Sectors

Industry Sector	CTE Pathway Name	Code	Pathway
Health Science and Medical Technology	Health Informatics	192	0%
Health Science and Medical Technology	Healthcare Administrative Services	250	0%
Health Science and Medical Technology	Healthcare Operational Support	197	1%
Health Science and Medical Technology	Mental and Behavioral Health	195	0%
Health Science and Medical Technology	Patient Care	198	8%
Health Science and Medical Technology	Public and Community Health	199	1%
Health Science and Medical Technology	Support Services	193	0%
Health Science and Medical Technology	Therapeutic Services	194	0%
Hospitality, Tourism, and Recreation	Food Science and Nutrition	200	2%
Hospitality, Tourism, and Recreation	Food Service and Hospitality	201	7%
Hospitality, Tourism, and Recreation	Hospitality and Recreation	202	1%
Information and Communication Technologies	Computer Hardware and Networking Engi..	151	0%
Information and Communication Technologies	Games and Simulations	175	0%
Information and Communication Technologies	Information Support and Services	170	3%
Information and Communication Technologies	Media Support and Services	171	0%
Information and Communication Technologies	Networking	172	0%
Information and Communication Technologies	Programming and Systems Development	173	0%
Information and Communication Technologies	Software and Systems Development	174	3%
Manufacturing and Product Development	Graphic Production Technologies	210	1%
Manufacturing and Product Development	Introductory/Core	214	0%
Manufacturing and Product Development	Machining and Forming Technologies	212	1%
Manufacturing and Product Development	Product Innovation and Design	216	0%
Manufacturing and Product Development	Welding and Materials Joining	213	1%
Manufacturing and Product Development	Emerging Technologies in Manufacturin..	215	0%
Manufacturing and Product Development	Integrated Graphics Technology	211	0%
Marketing, Sales, and Services	E-Commerce	240	0%
Marketing, Sales, and Services	Entrepreneurship/Self-Employment	241	2%
Marketing, Sales, and Services	International Trade	242	0%
Marketing, Sales, and Services	Marketing	244	1%
Marketing, Sales, and Services	Professional Sales	243	2%
Public Services	Emergency Response	233	1%
Public Services	Human Services	230	0%
Public Services	Legal Practices	231	1%
Public Services	Public Safety	232	3%
Transportation	Aviation and Aerospace Transportation..	222	0%
Transportation	Operations	223	0%
Transportation	Structural Repair and Refinishing	220	0%
Transportation	Systems Diagnostics and Repair	221	4%

Note: This table includes 74 CTE Pathways included in data obtained from California Department of Education.

Table A.2. Characteristics of CTE Pathway Completers by Pathway, 2015-2016

	Male	SED	English Learners	Students with Disabilities	Asian	African American	Latino	White	SBAC ELA Scale Score	SBAC Math Scale Score	Rural	Suburban	Town	Urban
Agriculture and Natural Resources	49%	59%	14%	10%	6%	2%	54%	35%	2574.88	2537.48	14%	36%	20%	30%
Agricultural Business	41%	48%	10%	8%	5%	2%	42%	49%	2583.90	2550.69	11%	42%	22%	25%
Agricultural Mechanics	84%	55%	14%	12%	3%	1%	45%	47%	2554.82	2526.22	22%	32%	28%	19%
Agriscience	46%	56%	13%	10%	4%	2%	50%	40%	2571.21	2533.21	16%	45%	18%	21%
Animal Science	38%	52%	10%	9%	4%	2%	50%	41%	2591.89	2550.96	11%	44%	16%	30%
Forestry and Natural Resources	46%	34%	6%	5%	30%	5%	24%	37%	2651.82	2640.40	7%	41%	8%	44%
Ornamental Horticulture	36%	66%	17%	10%	4%	3%	63%	28%	2572.30	2527.59	14%	36%	17%	33%
Plant and Soil Science	55%	63%	15%	9%	4%	4%	52%	37%	2563.80	2525.81	19%	21%	12%	49%
Arts, Media, and Entertainment	55%	55%	12%	9%	12%	5%	52%	28%	2601.83	2566.98	6%	48%	4%	42%
Design and Media Arts	57%	56%	13%	8%	13%	5%	53%	26%	2597.51	2565.89	6%	46%	4%	44%
Game Design and Integration	82%	50%	13%	14%	22%	2%	40%	32%	2612.20	2595.57	4%	48%	5%	43%
Performing Arts	32%	50%	8%	7%	9%	4%	47%	37%	2629.88	2586.11	10%	61%	6%	23%
Production and Managerial Arts	59%	52%	10%	10%	11%	6%	49%	31%	2601.88	2559.36	3%	50%	4%	43%
Building and Construction Trades	82%	65%	16%	13%	6%	4%	59%	28%	2551.96	2520.59	10%	33%	14%	44%
Cabinetmaking and Woodworking	82%	61%	15%	13%	5%	3%	56%	33%	2557.10	2526.33	9%	37%	14%	40%
Engineering and Heavy Construction	80%	80%	27%	13%	7%	2%	79%	11%	2561.31	2526.47	1%	21%	2%	76%
Mechanical Systems Installation and R..	87%	60%	15%	14%	7%	3%	50%	32%	2563.48	2528.38	17%	27%	21%	35%
Residential and Commercial Construction	80%	70%	16%	13%	6%	7%	62%	23%	2545.59	2514.74	10%	30%	12%	48%
Business and Finance	53%	64%	14%	7%	16%	6%	60%	17%	2590.76	2561.24	4%	35%	7%	54%
Business Management	53%	63%	14%	8%	15%	6%	59%	17%	2591.21	2561.43	4%	32%	5%	59%
Financial Services	52%	69%	16%	7%	16%	4%	63%	14%	2591.32	2556.86	1%	44%	10%	45%
International Business	54%	73%	14%	5%	25%	3%	64%	7%	2585.06	2573.19	0%	45%	0%	55%

Table A.2 (continued). Characteristics of CTE Pathway Completers by Pathway, 2015-2016

	Male	SED	English Learners	Students with Disabilities	Asian	African American	Latino	White	SBAC ELA Scale Score	SBAC Math Scale Score	Rural	Suburban	Town	Urban
Education, Child Development, and Fam..	25%	63%	15%	7%	8%	5%	59%	25%	2583.31	2541.10	4%	42%	8%	47%
Child Development	19%	66%	17%	7%	8%	4%	64%	22%	2573.73	2529.80	3%	44%	8%	45%
Consumer Services	49%	64%	15%	11%	10%	6%	56%	25%	2570.73	2534.56	2%	42%	4%	51%
Education	26%	56%	12%	7%	8%	5%	52%	32%	2606.01	2562.67	5%	36%	9%	50%
Family and Human Services	25%	78%	20%	8%	7%	5%	70%	16%	2548.43	2513.44	1%	38%	1%	60%
Energy, Environment, and Utilities	67%	57%	14%	7%	14%	3%	50%	29%	2604.07	2577.51	3%	36%	9%	52%
Electromechanical Installation and Ma..	96%	41%	13%	9%	9%	0%	35%	52%	2591.97	2572.34	0%	59%	22%	20%
Energy and Power Technology	74%	59%	12%	7%	22%	5%	42%	29%	2614.34	2596.60	0%	18%	11%	71%
Environmental Resources	59%	56%	13%	6%	10%	3%	52%	30%	2610.27	2583.92	5%	18%	8%	69%
Telecommunications	76%	57%	15%	9%	16%	3%	50%	28%	2594.36	2572.84	2%	57%	7%	35%
Engineering and Architecture	76%	55%	10%	6%	16%	4%	50%	28%	2618.58	2609.21	4%	53%	4%	40%
Architectural Design	76%	58%	11%	7%	14%	3%	55%	25%	2610.15	2595.54	4%	53%	4%	40%
Engineering Design	78%	57%	9%	6%	16%	4%	50%	27%	2621.37	2618.11	3%	55%	2%	39%
Engineering Technology	77%	47%	10%	5%	17%	3%	44%	33%	2630.54	2628.09	1%	44%	5%	50%
Environmental Engineering	61%	50%	8%	5%	20%	4%	44%	28%	2620.09	2606.31	0%	30%	0%	70%
Fashion and Interior Design	16%	66%	17%	8%	8%	6%	63%	21%	2571.35	2520.77	4%	39%	7%	50%
Fashion and Merchandising	14%	62%	16%	8%	10%	7%	58%	23%	2578.20	2527.13	5%	37%	5%	53%
Interior Design	21%	60%	20%	3%	8%	2%	56%	31%	2583.34	2542.15	2%	66%	17%	14%
Personal Services	19%	76%	20%	12%	2%	5%	76%	16%	2551.46	2497.42	1%	35%	11%	53%

Table A.2 (continued). Characteristics of CTE Pathway Completers by Pathway, 2015-2016

	Male	SED	English Learners	Students with Disabilities	Asian	African American	Latino	White	SBAC ELA Scale Score	SBAC Math Scale Score	Rural	Suburban	Town	Urban
Health Science and Medical Technology	35%	61%	12%	5%	13%	6%	56%	22%	2602.61	2565.82	6%	46%	6%	42%
Biotechnology	40%	52%	7%	4%	26%	6%	40%	24%	2635.14	2608.54	6%	42%	1%	51%
Biotechnology Research and Development	38%	52%	2%	2%	20%	9%	32%	39%	2655.90	2618.95	12%	33%	0%	55%
Diagnostic Services	33%	28%	0%	0%	11%	0%	28%	56%	2654.47	2616.29	0%	100%	0%	0%
Health Informatics	29%	70%	13%	7%	15%	5%	59%	21%	2597.18	2557.43	3%	56%	0%	41%
Healthcare Administrative Services	39%	75%	15%	8%	11%	8%	70%	8%	2595.00	2556.42	1%	11%	5%	83%
Healthcare Operational Support	30%	71%	21%	3%	8%	4%	69%	16%	2591.42	2561.18	5%	52%	7%	37%
Mental and Behavioral Health	32%	64%	9%	4%	8%	3%	60%	24%	2611.10	2572.32	8%	40%	22%	30%
Patient Care	34%	62%	12%	5%	12%	6%	57%	22%	2599.39	2561.07	6%	46%	7%	41%
Public and Community Health	38%	70%	11%	5%	13%	11%	63%	11%	2598.70	2562.37	0%	12%	2%	85%
Support Services	39%	57%	12%	1%	19%	3%	45%	22%	2616.49	2601.72	7%	66%	27%	0%
Therapeutic Services	35%	66%	7%	3%	3%	5%	68%	22%	2610.73	2567.21	9%	69%	6%	16%
Hospitality, Tourism, and Recreation	48%	64%	15%	12%	10%	6%	58%	24%	2566.81	2529.47	5%	43%	9%	44%
Food Science and Nutrition	48%	56%	12%	12%	11%	5%	54%	27%	2577.61	2538.19	4%	36%	6%	54%
Food Service and Hospitality	49%	65%	16%	12%	10%	6%	58%	25%	2564.71	2528.10	5%	44%	9%	41%
Hospitality and Recreation	44%	70%	17%	9%	10%	6%	64%	18%	2571.13	2529.17	7%	46%	5%	42%
Information and Communication Technol..	65%	59%	13%	8%	17%	5%	51%	24%	2604.12	2578.12	8%	39%	6%	48%
Computer Hardware and Networking Engi..	94%	43%	6%	9%	19%	4%	35%	40%	2625.53	2635.67	4%	21%	7%	68%
Games and Simulations	77%	51%	10%	8%	33%	3%	28%	32%	2641.83	2639.60	7%	43%	10%	41%
Information Support and Services	60%	71%	16%	9%	13%	7%	61%	16%	2577.73	2539.98	7%	32%	6%	55%
Media Support and Services	68%	65%	6%	7%	7%	2%	59%	28%	2611.68	2572.00	2%	56%	8%	33%
Networking	75%	67%	13%	9%	12%	3%	59%	23%	2596.31	2570.02	2%	35%	11%	52%
Programming and Systems Development	79%	23%	4%	13%	32%	3%	19%	44%	2678.01	2683.77	4%	58%	2%	36%
Software and Systems Development	68%	49%	11%	7%	21%	4%	41%	30%	2625.07	2607.23	9%	45%	4%	42%

Table A.2 (continued). Characteristics of CTE Pathway Completers by Pathway, 2015-2016

	Male	SED	English Learners	Students with Disabilities	Asian	African American	Latino	White	SBAC ELA Scale Score	SBAC Math Scale Score	Rural	Suburban	Town	Urban
Manufacturing and Product Development	75%	52%	11%	12%	8%	4%	46%	38%	2578.64	2555.77	8%	41%	13%	38%
Graphic Production Technologies	58%	50%	9%	11%	12%	6%	46%	34%	2598.23	2569.68	7%	29%	8%	56%
Introductory/Core	75%	56%	4%	7%	32%	5%	36%	21%	2600.00	2590.81	7%	89%	4%	0%
Machining and Forming Technologies	81%	55%	11%	11%	7%	3%	53%	35%	2569.73	2550.67	4%	54%	9%	34%
Product Innovation and Design	78%	41%	11%	9%	12%	3%	34%	47%	2605.83	2600.41	6%	49%	4%	41%
Welding and Materials Joining	92%	55%	14%	16%	2%	2%	48%	43%	2544.46	2516.84	13%	41%	28%	18%
Emerging Technologies in Manufacturin..	86%	31%	17%	7%	7%	3%	34%	41%	2606.50	2596.22	33%	53%	10%	3%
Integrated Graphics Technology	67%	47%	0%	13%	13%	8%	28%	45%	2603.64	2582.59	0%	57%	16%	27%
Marketing, Sales, and Services	52%	63%	14%	8%	11%	7%	59%	20%	2577.54	2541.41	6%	37%	2%	56%
E-Commerce	100%	40%	20%	0%	20%	0%	60%	20%	2608.80	2602.40	0%	80%	20%	0%
Entrepreneurship/Self-Employment	52%	68%	14%	8%	11%	7%	64%	16%	2575.63	2540.53	3%	35%	2%	61%
International Trade	0%	100%	0%	0%	0%	0%	100%	0%	2621.00	2492.00	0%	100%	0%	0%
Marketing	55%	50%	10%	7%	15%	8%	42%	32%	2595.10	2557.95	12%	36%	2%	50%
Professional Sales	49%	65%	15%	9%	9%	6%	62%	20%	2571.82	2533.84	5%	35%	3%	58%
Public Services	55%	64%	15%	9%	6%	5%	63%	24%	2575.20	2530.73	7%	54%	9%	30%
Emergency Response	69%	48%	10%	11%	5%	2%	47%	42%	2567.71	2520.03	18%	50%	9%	23%
Human Services	33%	67%	6%	12%	14%	10%	51%	20%	2617.63	2572.60	20%	61%	0%	20%
Legal Practices	50%	71%	16%	7%	10%	12%	64%	12%	2571.14	2527.61	5%	25%	11%	58%
Public Safety	55%	65%	16%	9%	5%	3%	66%	23%	2577.12	2532.52	5%	60%	8%	26%
Transportation	89%	66%	20%	14%	7%	3%	63%	25%	2545.26	2516.86	5%	46%	10%	38%
Aviation and Aerospace Transportation..	94%	48%	7%	12%	10%	8%	42%	27%	2571.56	2511.32	4%	2%	18%	76%
Operations	80%	83%	31%	7%	1%	7%	79%	10%	2546.93	2513.74	1%	37%	49%	13%
Structural Repair and Refinishing	90%	67%	20%	15%	3%	2%	71%	22%	2523.61	2494.74	10%	42%	2%	46%
Systems Diagnostics and Repair	89%	66%	20%	14%	7%	3%	62%	26%	2546.30	2518.79	5%	47%	11%	37%