Measures for a College and Career Indicator: Course-Taking Behavior

Prepared for the California Department of Education by the Educational Policy Improvement Center

David T. Conley

with

Paul Beach
Michael Thier
Sarah Collins Lench
Kristine L. Chadwick

June 2014

Introduction

In September 2012, Governor Jerry Brown signed into law Senate Bill 1458, which calls for California's school accountability system to shift from a near-exclusive reliance on state test scores to a broader range of measures demonstrating student achievement. At the high school level, starting in the 2015–16 school year, the Academic Performance Index will include an indicator composed of measures reflecting students' college and career preparedness. This white paper, however, concerns itself exclusively with high school performance. As a result, this report uses school and high school interchangeably.

To determine exactly what measures will be included in this new indicator, the State Superintendent of Public Instruction and the State Board of Education will consider input from regional public meetings, a statewide survey, and recommendations from the Public Schools Accountability Act Advisory Committee. To further support this decision-making process, the California Department of Education has contracted with the Educational Policy Improvement Center (EPIC) to evaluate five different categories of potential measures of college and career preparedness. The first five white papers in this series each summarize one of those categories to examine which measure or measures should be included in a college and career indicator. The sixth white paper discusses opportunities and challenges of a multiple measure system. A final report summarizes findings from all six white papers. In this series of white papers, the term *measure* is a discrete metric used to determine an aspect of college and career preparedness. The term *indicator* refers to a system that comprises one or more college and career preparedness measures.

This white paper considers course-taking behavior—specifically the a–g subject requirements for the University of California (UC) and the California State University (CSU) systems, career technical education (CTE) course pathways, and an integrated course pathway—as potential measures to be included in California's college and career indicator. This white paper begins by presenting a brief overview of the a–g subject requirements and CTE course pathways, their respective histories, their current applications to other state accountability systems, and the connections between both sets of course-taking behaviors. Next, the a–g subject requirements and CTE course pathways are evaluated against the framework being used for all five categories of potential college and career preparedness measures. This white paper concludes with a summary that identifies major strengths, weaknesses, and tradeoffs.

A–G Subject Requirements

The a–g subject requirements are a set of 15 yearlong high school courses required for admission to each of the 10 campuses within the UC system and the 23 campuses within the CSU system. These 15 courses span six content areas (a–f) and one elective area (g). Students must complete all 15 yearlong courses with a grade of C or better. Grades of D or lower can be validated by grades of C or higher in more advanced courses or by SAT, Advanced Placement, or International Baccalaureate exam scores. The requirements for the UC and CSU systems are almost identical, with

the only differences relating to which specific course titles are required, the timeline for completing courses, and the validation policies for grades of C or lower.[1] For instance, students can satisfy the laboratory science requirement (d) for admission to the UC system by choosing to take two years in biology, chemistry, or physics. In the CSU system, students must take one year of both biology and a physical science. Another difference is that students must complete 11 of the 15 courses before their senior year for admission to the UC campuses. There is no such requirement for CSU schools.

California's high school graduation requirements include 12 yearlong courses in the same subject areas as a–f. Students do not need to complete an elective (g) to graduate from high school in California. The graduation requirements require one less year of mathematics, English, and a language other than English, but mandate one more year of history/social science and two years of physical education. Table 1 provides a side-by-side comparison of the entrance requirements for the UC and CSU systems and the state's mandated high school graduation requirements.

Table 1. California High School Graduation Requirements, CSU Admission Requirements, and UC Admission Requirements

Subject area	CA high school graduation requirements	CSU subject requirements	UC a–g subject requirements
(a) History/social science	**3 years** U.S. history and geography, world history or culture and geography, and ½ government, ½ civics	**2 years** U.S. history or American government and a social science course	**2 years** world history, cultures and historical geography and either U.S. history or ½ U.S. history and ½ government
(b) English	**3 years**	**4 years** college preparatory English that includes composition and literature	**4 years** college preparatory English that includes literature, writing, speaking and listening
(c) Mathematics	**2 years** including Algebra I	**3 years (4 recommended)** Algebra I, geometry, Algebra II	**3 years (4 recommended)** Algebra I, geometry, Algebra II
(d) Laboratory science	**2 years** biological and physical sciences	**2 years** biology and physical science	**2 years (3 recommended)** chosen from biology, chemistry, and physics
(e) Language other than English	**1 year** art, foreign language, or career technical education	**2 years** of the same language, including American Sign Language	**2 years (3 recommended)** of the same language or equivalent to second level of high school instruction
(f) Visual and performing arts	**1 year** art, foreign language, or career technical education	**1 year** dance, drama/theater, music, or visual art	**1 year** dance, drama/theater, music, or visual art
(g) College preparatory elective	**Not applicable**	**1 year**	**1 year**
Physical education	**2 years**	**Not applicable**	**Not applicable**

[1] A complete description of the differences between UC and CSU course-taking entrance requirements can be found at www.calstate.edu/sas/onestopkiosk/documents/csu-uc-a-gcomparisonmatrix.pdf

High school courses intended to meet the a–g subject requirements are submitted to an audit process that provides a measure of quality. The a–g Interactive Guide Project of 1999 was designed to make the a–g approval process more transparent, clarify course evaluation criteria, and provide resources to educators submitting courses for approval. Today, all a–g courses are evaluated by the University of California Office of the President. Details of the evaluation system are presented in the Stability section (A3), but essentially all courses must satisfy seven standard guidelines and specific subject-area requirements.

CTE Pathways

Historically, the Federal government has been the driver of policy for CTE, starting with the Smith Hughes Act of 1917, continuing with the Vocational Education Act of 1963, and culminating with the reauthorization of the 1984 Carl D. Perkins Vocational Education Act in 2006, now called the Carl D. Perkins Career and Technical Education Act and hereafter referred to as Perkins IV. The reauthorization of Perkins IV also signified a shift in the language used to describe career-oriented education. Prior to 2006, CTE was referred to as vocational education and was considered a separate track from core academics. Students intent on pursuing a college education enrolled in courses in the academic track; students not headed for college pursued vocational education. Over time, the boundaries between college preparatory and CTE curricula have become less distinct, although de facto tracking can still be found in many schools. Rigorous academic content has become integrated into CTE curriculum in a way that recognizes the need for and relevance of students pursuing both college and career postsecondary pathways.

Today in California, CTE is expanding, innovating, and diversifying, supported by an array of partnerships among high schools, industry, community and technical colleges, workforce development agencies, and trade associations. The type of CTE delivery structure available to students varies by location and includes individual high school courses, career academies within comprehensive high schools, Regional Occupation Centers and Programs, internships, apprenticeships, and other workplace experiences (O'Connell & Woodruff, 2008). In 2013, California's public and alternative high schools offered approximately 42,610 CTE courses or approximately 11 CTE courses for a high school with 1,400 students (California Department of Education, 2013). In addition to individual courses taught within high schools, 473 state-funded California Partnership Academies, which are smaller learning communities inside high schools, require cohorts of students to take a set of core academic courses and at least one CTE course together each year.

High schools also partner with business and industry to supplement coursework with workplace exposure and experience. Work Experience Education administered through high schools offers students the opportunity to combine on-the-job training with classroom academic and technical skill instruction to help students explore career options, develop workplace skills, and prepare students for full-time employment (O'Connell & Woodruff, 2008).

Table 2. California's 15 Industry Sectors and 58 Career Pathways

Agriculture and Natural Resources • Agricultural Business • Agricultural Mechanics • Agriscience • Animal Science • Forestry and Natural Resources • Ornamental Horticulture • Plant and Soil Science	**Health Science and Medical Technology** • Biotechnology • Patient Care • Health Care Administrative Services • Health Care Operational Support Services • Public and Community Health • Mental and Behavioral Health
Arts, Media, and Entertainment • Design, Visual, and Media Arts • Performing Arts • Production and Managerial Arts • Game Design and Integration	**Hospitality, Tourism, and Recreation** • Food Science, Dietetics, and Nutrition • Food Service and Hospitality • Hospitality, Tourism, and Recreation
Building and Construction Trades • Cabinetry, Millwork, and Woodworking • Engineering and Heavy Construction • Mechanical Systems Installation and Repair • Residential and Commercial Construction	**Information and Communication Technologies** • Information Support and Services • Networking • Software and Systems Development • Games and Simulation
Business and Finance • Business Management • Financial Services • International Business	**Manufacturing and Product Development** • Graphic Production Technologies • Machining and Forming Technologies • Welding and Materials Joining • Product Innovation and Design
Education, Child Development, and Family Services • Child Development • Consumer Services • Education • Family and Human Services	**Marketing, Sales, and Services** • Marketing • Professional Sales • Entrepreneurship/Self-Employment
Energy, Environment, and Utilities • Environmental Resources • Energy and Power Technology • Telecommunications	**Public Services** • Public Safety • Emergency Response • Legal Practices
Engineering and Architecture • Architectural Design • Engineering Technology • Engineering Design • Environmental Engineering	**Transportation** • Operations • Structural Repair and Refinishing • Systems Diagnostics, Service, and Repair
Fashion and Interior Design • Fashion Design and Merchandising • Interior Design • Personal Services	

California's 74 Regional Occupation Centers and Programs partner with community colleges, industry, and business, and workforce investment boards to provide secondary and adult students with the advanced education and technical skills necessary to pursue college and career postsecondary pathways. Created in the 1970s, Regional Occupation Centers and Programs provide students with access to academic and technical training through one of three organizational structures: a) school districts participating in an Regional Occupation Centers and Program operated by a county office of education, b) school districts participating under a joint powers agreement, and c) a single school district (O'Connell & Woodruff, 2008). Discussion of the community college and adult student CTE delivery structures is outside the scope of this white paper.

Distinct CTE course pathways consisting of three to four courses aligned to the California CTE Model Curriculum standards are increasingly available to California's high school students. These course pathways generally start in the 10th grade. The California CTE Model Curriculum standards were developed with input from business, industry, and secondary and postsecondary education representatives, and were adopted by the State Board of Education in 2005. These standards are organized across 15 industry sectors and include 58 distinct career pathways (see Table 2).

In 2011, the CTE Model Curriculum standards were revised to align with the Common Core State Standards (Common Core), the Next Generation Science Core Ideas, and California's history/social science Standards. The CTE Model Curriculum standards may be refined further by the Common Career Technical Core. Like the Common Core, the Common Career Technical Core is a state-led initiative involving input from business, industry, and secondary and postsecondary education. California, 41 other states, and the District of Columbia are currently participating in the development of the Common Career Technical Core.

An Integrated Course Pathway

An additional way of considering the relationship between the a–g subject requirements and CTE course pathways is an integrated course pathway measure to reflect both college and career preparedness. An integrated course pathway measure would allow students to earn 1,000 Academic Performance Index points for completing both the a–g subject requirements *and* a CTE course pathway and passing a certification exam. Many possible combinations could be used in assigning Academic Performance Index points below the 1,000-point maximum. For example, students could earn 800 Academic Performance Index points for a) completing the a–g subject requirements *or* b) completing a CTE course pathway and passing a certification exam. However, data simulations using requirement completions and exam pass rates of previous students will be necessary to create an integrated course pathway measure that reflects realistic expectations, adequately addresses both college and career preparedness, and limits perverse incentives such as student tracking.

This type of measure could better reflect the direction of state policy in relation to CTE. Over the past decade the state of California has steadily been directing resources

and creating programs to support and expand CTE opportunities within schools. In addition to passing legislation creating CTE standards, the state has expanded programs including California Partnership Academies, Regional Occupation Centers and Programs, and the Linked Learning Pilot Program. Furthermore, the $250 million California Career Pathways Trust, signed into law in 2013, awards competitive grants to school districts that support CTE programs. To supplement state policy, UC has provided resources and support to integrate rigorous CTE courses into the a–g framework. For instance, the UC Curriculum Integration Institute was established in 2010 to develop exemplary CTE courses that satisfy a–g subject requirements (California Department of Education, 2013).

As a result, the number of CTE courses in California that are a–g approved has risen dramatically in the past decade. In 2001, fewer than 1% of CTE courses were a–g approved. By 2013, the percentage had increased to 23.3%. Approximately 46% of the CTE courses that are a–g approved can be used to satisfy the visual performing arts (f) subject requirement, 34% satisfy the college preparatory elective (g) requirement, and 15% satisfy the laboratory science (d) requirement. Photography was the most frequently approved CTE course under the visual performing arts (f) subject area. The most frequently approved CTE courses under the laboratory science (d) subject area were Anatomy & Physiology and Agricultural Biology. Many CTE course titles were used to satisfy the college preparatory elective (g) requirement. CTE courses that are a–g approved come from the following industry sectors: arts, media, and entertainment (43%); agriculture and natural resources (13%); health science and medical technology (12%); business education (11%); industrial and technology education (9%); and home economics careers and technology (3%).[2] In 2013, approximately 90% of California public high schools offered at least one a–g approved CTE course (California Department of Education, 2013).

The Linked Learning Alliance and other similar organizations are paving the way for an educational system that integrates rigorous academics with career-based and workplace learning. By providing an education that promotes college *and* career preparedness, the Linked Learning model ensures that students are prepared for all postsecondary pathways, whether it be attending college or formal job training. This type of system recognizes that students need rigorous training in academics as well as the metacognitive skills necessary to be successful in the 21st-century workforce. Research, which will be described below, shows that Linked Learning and similar models lead to increased high school graduation rates, increased eligibility for university admission, and increased lifetime earnings.

The infrastructure for an integrated course pathway measure that encourages students to complete both the a–g subject requirements and a CTE course pathway is already in place. This type of measure represents the current direction of CTE policy in the country and specifically in the state of California. Finally, as will be shown below, there is evidence that an integrated course pathway measure is more technically sound,

[2] Approximately 10% of a–g approved CTE courses fall across the other nine industry sectors.

has more stakeholder relevance, and provides greater utility for the educational system than operating the a–g subject requirements or CTE course pathways as distinct entities.

Course-Taking Behavior in Accountability

Beyond meeting minimum state graduation requirements, few state accountability systems include an measure of high school course-taking behavior that reflects course challenge level independent of whether the course meets college-entrance criteria. Georgia provides one of the few examples of an accountability system that measures both academic and CTE pathway completion. Georgia's Post High School Readiness metric includes an measure for the percentages of graduates completing a Career Technical and Agriculture Education Pathway, an advanced academic pathway, a fine arts pathway, or a world language pathway within their programs of study. Georgia accepts 96 CTAE pathways, and students are required to complete three to four courses in one of them. The advanced academic pathway in English language arts, mathematics, science, or social studies includes completing the graduation requirements in a chosen subject; an AP, IB, or dual enrollment course in the chosen subject; and three units in one language other than English. Completing the world language pathway requires the completion of three credits in one language. Finally, the fine arts/performing pathway requires completion of three courses in visual arts, dance, music, journalism, or theatre. The pathway completion measure is one of eight possible measures in the Post High School Readiness metric.

Other states with accountability systems with measures of course-taking behavior include New York, Maryland, New Mexico, and North Carolina. Students meeting one of 10 measures count once in the numerator for New York's College and Career Readiness metric. The denominator is the number of high school seniors eligible for graduation in four years. Each student who earns a high school diploma with a CTE or art endorsement by completing a certain number of credits is counted in the College and Career Readiness metric. Maryland's College and Career Readiness indicator consists of a school's five-year graduation rate and a measure of college and career preparation. Students are counted toward the College and Career Readiness indicator by scoring a 3 or higher on an Advanced Placement exam or a 4 or higher on an International Baccalaureate exam, attending college after high school, or by achieving advanced standing in a CTE program by being enrolled in the third course of an approved CTE program. In New Mexico, high school students can count toward their school's College and Career Readiness indicator by completing a career pathway with a grade of C or higher in all courses. North Carolina schools are held accountable to the number of students who complete and pass Algebra I/Integrated Math I. Finally, a number of states, including Florida, Georgia, Indiana, New Jersey, New York, and Ohio, measure the number of students earning an industry credential or certification by passing a CTE test, which often requires students to complete CTE coursework.

Evaluative Framework

Working in collaboration with the Public School Accountability Act Advisory Committee, EPIC developed an evaluative framework to provide a consistent, rigorous set of criteria by which each measure can be evaluated for its inclusion in the Academic Performance Index. This framework was adapted from the Advisory Committee's Academic Performance Index Guiding Principles and was supplemented with additional criteria specific to the charge of designing a college and career indicator. Organized under the dimensions of technical quality, stakeholder relevance, and system utility, the following 10 criteria explore the extent to which each measure under consideration:

- has a *research base* demonstrating a relationship with postsecondary success;
- allows for *fair comparisons*;
- has *stability*;
- has *value for students*;
- is *publicly understandable*;
- has *instructional sensitivity*;
- emphasizes *student performance*, not educational processes;
- *minimizes burden*;
- provides as much *student coverage* as possible; and
- recognizes *various postsecondary pathways*.

The design of the framework acknowledges that satisfaction of the above criteria is not a simple binary decision of yes or no. Evaluations will be nuanced, supported by research, and summarized on a consistent scale. Additionally, evaluations may sometimes place criteria in conflict with one another (e.g., a measure may have a strong research base but place an extraordinary implementation burden on schools). The purpose of this work is not to make recommendations, but rather to provide decision makers with the necessary information to identify strengths, weaknesses, and trade-offs associated with each measure considered for inclusion in the college and career indicator. Each criterion below will be rated on a three-point scale: strong, moderate, or weak.

The following subsections evaluate the a–g subject requirements, CTE pathway completion, and an integrated course pathway against the framework, taken as both distinct measures and as a general category of course-taking behavior.

A. Technical Quality

For the purpose of this white paper, technical quality is defined as having predictive validity for forecasting how students will perform in postsecondary pathways, allowing fair comparisons among different subpopulations of students, and having sufficient stability to allow for examination of trends.

A1. Research Base

The first of the 10 evaluative criteria considers the empirical research base to ascertain the degree to which it describes the relationship between the measure and postsecondary success. For the purposes of this project, research on postsecondary success may include a wide array of outcome variables including college matriculation, persistence, course grades, grade-point average, and degree completion. Career success outcome variables may be defined extrinsically (e.g., salary or promotion) or intrinsically (e.g., self-reported job satisfaction). This section begins by describing the research base showing the relationship between the a–g subject requirements and college and career postsecondary success. The research base in relation to CTE courses is described next, and the section concludes with a discussion of an integrated course pathway.

Several studies suggest that taking more advanced academic courses in high school increases entry into and performance in college. Adelman's (1999, 2006) widely cited research used data from the National Center for Education Statistics High School and Beyond data set and found that academic intensity of a student's high school curriculum had the highest correlation with bachelor degree attainment.[3] Long, Conger, and Iatarola (2012) found that requirements or encouragements that students take even one rigorous course in English, mathematics, science, social studies, or in a language other than English substantially improved rates of college enrollment, the likelihood of earning college credit while in high school, college grade point average, and college persistence, regardless of subject. Students taking a rigorous course in their first two years of high school increased college enrollment by 5–6%. Few researchers have explored the effects of high school academic curriculum on career success.

Some researchers have explored the effects of taking courses in specific academic subjects on college and career success, with mathematics being the most heavily studied subject. Mathematics course taking, and specifically the timely completion of Algebra I, is strongly related to postsecondary success (Adelman, 1999, 2006; Finkelstein & Fong, 2008; Finkelstein, Fong, Tiffany-Morales, Shields, & Huang, 2012; Trusty & Niles, 2003), and career earnings (Rose & Betts, 2004), especially for women (Levine & Zimmerman, 1995) and African American men (Goodman, 2012). Few researchers have explored the differential impacts of advanced courses in other subjects. However, research shows that advanced courses in science (Schwartz, Sadler, Sonnert, & Tai, 2009) and the arts (Catterall, 2009) are also correlated with postsecondary success.

[3] The highest of the 31 gradations of academic curriculum intensity included a) 3.75 or more Carnegie units of English, b) 3.75 or more units of mathematics, c) highest mathematics of either calculus, precalculus, or trigonometry, d) 2.5 or more units of science *or* more than 2.0 units of core laboratory science (biology, chemistry, and physics), e) more than 2.0 units of foreign languages, f) more than 2.0 units of history and social studies, g) or more units of computer science, h) more than one AP course, and i) no remedial English; no remedial mathematics.

Extensive research has analyzed the effects of career academies on academic and career success. Most of this research has focused on high school attendance, grades, and graduation, as well as lifetime earnings, but some research has explored the effect of career academies on college success. Kemple (2004) and Kemple and Willner (2008) used a random assignment study design, where a lottery system was used to determine which students enrolled in career academies, to analyze the postsecondary and labor market outcomes of students in nine career academies across the U.S. The results showed career academies to be a viable pathway to a range of college opportunities, but the difference between career academy and nonacademy students was not significant. In other words, career academies did not improve or diminish a student's chance of enrolling and succeeding in college when compared to regular high school students. The Center for Advanced Research and Technology (2011) analyzed 15 high schools that used a Linked Learning model that combined rigorous academics with instruction in career clusters. The researchers found that 71% of career academy students attended community college compared to 60% of demographically similar non-academy students.

Other researchers have found that career academies lead to higher levels of college preparedness among students. Dayton, Hester, and Stern (2011) analyzed 467 California Partnership Academies in 278 California high schools and found that 57% of graduates from California Partnership Academies fulfilled the a–g subject requirements, compared to 36% statewide. Lekes et al. (2007) found that CTE students felt more prepared for the transition to college and careers than non-CTE students. Finally, Maxwell and Rubin (1997) showed that the proportion of students in career academies needing remediation in college was lower than the proportion of nonacademy students needing remediation. Career academy students also had higher college graduation rates when compared to nonacademy students.

The effects of CTE also extend to outcomes in the labor market in the form of higher earnings for students (Bishop & Mane, 2004; Kemple, 2004; Kemple & Willner, 2008). Kemple (2004) and Kemple and Willner (2008) found that male students in career academies earned 17% more per year than a control group ($3,731 in 2006 dollars) and suggested that career academy students realized this benefit as a result not only of increased wages but also higher levels of hours worked and employment stability. A possible explanation for these findings is the increased likelihood of CTE students graduating with a clear career goal and having developed metacognitive skills such as problem solving, project completion, communication, and time management (Lekes et al., 2007). Bishop and Mane (2004) found that students who devoted one sixth of their time in high school to CTE education earned 12% more the year after graduation and 8% more over the next seven years. Earnings were higher for students who trained for specific occupations.

As distinct course pathways, neither a–g nor CTE course pathway completion are strongly related to *both* college and career success. The a–g subject requirements are nearly identical to Adelman's (1999, 2006) most intense academic curriculum, which is a strong predictor of postsecondary success, but little evidence exists to describe how

this type of academic preparation influences labor market outcomes. Likewise, more research is needed to understand the relationship between college success and English, science, languages other than English, and social science courses. There is moderate evidence that CTE courses positively predict college success (Dayton et al. 2011) but strong evidence that completing a specific career and technical education pathway leads to increased wages, regardless of other factors (Bishop & Mane, 2004; Kemple, 2004; Kemple & Willner, 2008). The research findings support the contention that an integrated course pathway, one requiring completion of a–g and a CTE course pathway, has the potential to be a strong measure of college *and* career preparedness, regardless of what postsecondary pathway a student chooses to pursue.

A–G subject requirements:	Strong	
CTE course pathway:	Moderate	
Integrated course pathway:	Strong	Category: Strong

A2. Fair Comparisons

This evaluative criterion is based on the assumption that the Academic Performance Index must give all students a fair chance to show what they know and have learned. For the purposes of this white paper, the extent to which a measure provides fair comparisons across students and schools is determined by careful attention to bias.

Fairness in relation to the a–g subject requirements and CTE course pathways is determined by a student's access to college preparatory and CTE courses, also known as opportunity-to-learn. Pursuant to California Education Code 51228, all school districts in California serving grades 7–12 must offer students a four-year course of study fulfilling the requirements and prerequisites for admission to California institutions of higher education *and* provide an opportunity for students to attain entry-level employment skills in business or industry. However, beyond issues of basic access, high schools do not present equal opportunities to students. Inequalities in opportunity-to-learn can result from a lack of rigorous course offerings and a lack of materials or resources necessary for effective instruction. Adelman (2006) found that poor students are less likely to attend a high school that offers a mathematics course above Algebra II. A RAND Corporation study showed that California schools with high percentages of minorities had an average of 20% of teachers without full credentials, compared to only 4% in low-minority schools. Similar disparities were found in low-performing schools and schools with high percentages of students who were eligible for free and reduced-price lunch. Teachers in mathematics, physical science, and special education were the most likely not to have credentials (Carroll, Krop, Arkes, Morrison, & Flanagan, 2005). Furthermore, Oakes and Sanders (2004) found that schools serving low-income students and English learners are most affected by shortages in quality textbooks, curriculum materials, and technology.

These disparities may help to explain why some subgroups of students fall off the pathway to completing the a–g subject requirements. Hispanic, African American, American Indian/Alaska Native, and Pacific Islander students, and students receiving

free and reduced-priced lunch, are less likely to pass the benchmark a–g courses (Algebra I, English 9, Geometry AB, English 10 AB, Algebra II, and Chemistry AB) with a grade of C or better by the end of grade 11 (Choi & Shin, 2004). Hispanic and African American students are far less likely to complete the a–g English, mathematics, or laboratory science requirements than white or Asian students. Many of these students fall off track in the 9th grade and never recover (Finkelstein & Fong, 2008).

EPIC analyzed CTE data from 1,278 California high schools, excluding schools without reportable Academic Performance Index data or schools with less than 90% of its student body at or above ninth grade standing. The 167 high schools identified as offering no CTE courses reported disproportionately high rates of students eligible for free and reduced-priced lunch. When examining the remaining 1,111 schools that do offer CTE courses, EPIC found significant differences in the percentage of CTE completers and student-to-CTE course ratio on the basis of economic disadvantage. Schools in the quartile with the most economically disadvantaged students had higher CTE course pathway completion rates (7.5%) than schools with the least economically disadvantaged students (4.6%). However, the student-to-CTE course ratio did not follow the same pattern. Schools with the most economically disadvantaged students had the highest ratio of students to CTE courses (196:1), meaning either larger class sizes or reduced access. The least economically disadvantaged schools had a ratio of 171:1. Schools in the middle two quartiles, with neither the least nor most economically disadvantaged students, had both the highest CTE completion rates among students and the lowest student-to-CTE course ratios.

Still, some CTE programs are designed to target disadvantaged students. For instance, by law, 50% of incoming California Partnership Academies cohorts must be at-risk students, defined by meeting three of six criteria (Dayton et al., 2011).[4] Furthermore, 70% of Perkins IV funds are allocated based on a county's proportional share of the state's total K–12 enrollment that is eligible for free and reduced-priced lunch. Based on overall data from 2007, males and white students were slightly overrepresented in CTE enrollment. However, the distribution of students by ethnicity was consistent with statewide high school enrollment.

Research suggests that although students have access to the a–g and CTE courses, not all students have an equal opportunity to pass these courses (Carroll et al., 2005; Finkelstein & Fong, 2008). Minority students and those eligible for free and reduced-priced lunch are less likely to be taught by teachers with appropriate credentials and more likely to lack access to adequate learning materials. This is especially true in mathematics, which research shows has the strongest relationship with postsecondary success of all the academic subjects. Subsequently, these students are less likely to complete the a–g subject requirements. Schools in the most advantaged quartile of schools reported the lowest percentages of CTE completers; however, students in advantaged high schools had better CTE access than peers

[4] Six at-risk criteria: a) having a poor attendance record, b) being significantly behind on credits earned, c) demonstrating low motivation, d) being economically disadvantaged, e) having low state test scores, and f) having a low grade point average.

attending the most economically disadvantaged schools. CTE funding targeted to at-risk students may alleviate some of these concerns.

A–G subject requirements:	Moderate	
CTE course pathway:	Moderate	
Integrated course pathway:	Moderate	Category: Moderate

A3. Stability

This evaluative criterion is chiefly concerned with how the measure contributes to the comparability and flexibility of the Academic Performance Index as a whole over time. In order to measure school performance and improvement consistently over time, all components of a measurement system should be based on definitions that remain relatively constant from year to year. Likewise, the core measures within the college and career indicator need to be reasonably stable. If they are, then the Academic Performance Index has some capacity to incorporate future component measures of preparedness, which is important due to the dynamic nature of college and career preparedness.

For course-taking behavior to be a stable measure of college and career preparedness, courses across schools must be comparable and of consistent quality. Studies by EPIC demonstrated that entry-level college and job-training program courses with the same or similar course titles across different institutions showed variations in prerequisite knowledge, skills, and abilities for incoming students (WestEd and EPIC, 2013; EPIC, 2014). In high schools, course quality would likely covary with quality among teachers, classrooms, schools, and other contextual factors. Studies incorporating so many variables have not surfaced in the literature on high school course-taking, creating a challenge for using course-taking behavior as a college and career indicator without controlling for content and quality through methods of standardization. Common standards increase course consistency, as do course audits and validation processes. However, a trade-off of standardizing coursework might be limiting options and thereby restricting a school's ability to meet local needs.

The University of California Office of the President course evaluation process underscores California's existing recognition of the need to ensure the quality of courses across schools using an audit process to evaluate every a–g course offered in California high schools, including CTE courses used to satisfy a–g subject requirements. However, in 2013, more than three fourths of CTE courses offered in California did not undergo any external review process for consistent content or quality because they were not designed to satisfy a–g course requirements. UC course evaluations are required when a new course is added, a course previously approved by UC is added within a new context,[5] a course changes from the approved subject area,

[5] When the content of the course has already been a–g approved a complete course description is not required. Previously approved courses include: a) AP, IB, and Regional Occupation Centers and Program courses, b) courses approved at another school within a school's district, c) courses removed within the last three years and seeking reinstatement, d) UC-approved courses from an online course publisher, e) courses modeled after others offered outside a school's district.

an honors designation is added to an existing course, a course is lengthened, or other significant changes are made to a previously approved course. Schools have three opportunities to submit courses during the annual cycle. University of California Office of the President subject-area analysts conduct blind reviews and evaluate courses based on guidelines relating to seven characteristics of the course:

1) brief course description
2) textbooks/supplemental instructional materials
3) course purpose
4) course outline
5) key assignments
6) instructional methods and/or strategies
7) assessment methods and/or tools

Courses are evaluated on these guidelines and subject-area requirements. A reviewers' committee and, if necessary, a UC faculty member will review courses if the University of California Office of the President subject-area analyst cannot determine if a course should be approved. The University of California Office of the President website provides detailed course description templates, sample courses, and detailed guidelines for submitting courses for educators designing a–g courses.

The University of California Office of the President course evaluation system is important for ensuring that a–g courses contain similar content and are of consistent quality. However, this system does not ensure that courses are aligned to the Common Core State Standards or the CTE Model Curriculum standards, although University of California Office of the President maintains that the a–g course criteria are consistent with the underlying goals of the Common Core. One potential solution would be to introduce a system allowing educators to align course content to both the Common Core and CTE Model Curriculum standards using a common syllabus framework. For example, CourseCreate, an online system designed by EPIC and used extensively in Maine and elsewhere, allows educators to design courses aligned to the Common Core (and/or state or subject-area standards) using a common syllabus template. Instructors build their courses, adding units and activities; at each step, they select from the embedded list of the Common Core standards that are addressed for each unit and activity. Once syllabi are created, the CoursePathway tool analyzes whether the set of courses (within a school or across a district) adequately covers the necessary Common Core standards. A similar system, once created, would ensure that all courses adequately cover the appropriate standards. In the absence of such a system, the stability of CTE pathway completion cannot be fully determined.

The University of California Office of the President course evaluation system provides some stability to a–g courses by ensuring consistent quality and content across schools. Incorporating a component to the University of California Office of the President course evaluation system that aligns course content to the appropriate standards would improve the stability of a course-taking behavior measure. To further improve stability, an equally rigorous or systemic process is needed for reviewing the

quality of CTE courses not a–g approved (approximately 77% of all CTE courses in California). Without this process, the stability of CTE course pathways is weak.

A–G subject requirements:	Moderate	
CTE course pathway:	Moderate	
Integrated course pathway:	Moderate	Category: Moderate

B. Stakeholder Relevance

Accountability measures that are relevant to a variety of education stakeholder groups for more purposes than solely rating a school or district provide greater value to the levels of the education system than measures that meet only school and district accountability requirements. The extent to which measures can serve multiple purposes may help increase stakeholder acceptance of an accountability system.

B1. Value for Students

This evaluative criterion is chiefly concerned with the extent to which the component measures of the college and career indicator are likely to be actionable and accepted by students. Rather than an assessment or data point that is only valuable in making system-level determinations of school quality, a college and career indicator with student currency reflects and creates incentives for behaviors and performances that directly affect or improve an individual student's prospects for postsecondary success.

The a–g subject requirements provide direct educational value to students by satisfying course-taking admission requirements at all public institutions of higher education in California.[6] Satisfying these course-taking requirements represents the first hurdle for many students applying to college, because it provides colleges with a signal about a student's ability to persevere and complete a series of rigorous courses. Research referenced earlier indicated that completion of rigorous academic courses in high school increases a) the likelihood of earning college credit while in high school, b) college grade point average, and c) college persistence (Adelman, 1999, 2006; Long et al., 2012). EPIC examined the course-taking admission policies at flagship universities in all 50 states and found the a–g subject requirements to be slightly less rigorous than those of other states in relation to mathematics, social studies, and laboratory science requirements. The a–g subject requirements do satisfy the requirements for English and languages other than English at all 50 flagship universities.

CTE pathways can lead to industry certificates, which have obvious economic value. Such certificates provide students with self-efficacy about competencies related to the certificate and evidence for employers that the student possesses certain skills or knowledge sets (Foster & Pritz, 2006). Research presented earlier in this white paper suggests that CTE students graduate with clear career goals and have developed metacognitive skills valued by employers (Lekes et al., 2007). In addition to industry

[6] California community colleges are required to admit any California resident who has earned a high school diploma (California Department of Education, 2013).

certifications, CTE students can gain valuable experience through internships, apprenticeships, and other workplace opportunities. These experiences have the potential to further develop job preparedness and metacognitive skills associated with career success.

Students taking advanced CTE courses realize short- and long-term benefit by obtaining better jobs with higher rates of pay both immediately after high school and eight years later when compared to students whose high school experience did not include advanced CTE coursework (Bishop & Mane, 2004; Kemple, 2004; Kemple & Willner, 2008). Furthermore, the educational value of CTE pathways increases for students when they can access pathways fostering passionate engagement (Catterall, 2009) by receiving instruction or apprenticeships aligned directly to a desired future career. CTE and a–g pathways are not mutually exclusive; students in advanced CTE coursework should have in their curriculum rigorous courses of all types. Taking mathematics courses beyond the minimum required, in particular, has been shown to increase lifetime earnings (Rose & Betts, 2004).

An integrated course pathway measure would present students with more value than the a–g subject requirements or CTE course pathways as separate measures. Completing an integrated course pathway would provide students with educational value by fulfilling course-taking admission requirements for college and also equip students with career-oriented metacognitive skills necessary for success in both college and careers. Nationwide, less than two thirds of students complete four-year college programs in six or fewer years (DeAngelo, Franke, Hurtado, Pryor, & Tran, 2011). Graduation rates from two-year community college programs are also poor (Knapp, Kelly-Reid, & Ginder, 2011). The integrated course pathway would capitalize on the benefits of both rigorous coursework and career relevance offered by the a–g sequence and CTE courses.

A–G subject requirements:	Strong	
CTE course pathway:	Moderate	
Integrated course pathway:	Strong	Category: Strong

B2. Publicly Understandable

The Academic Performance Index is intended to give educational stakeholders—students, parents, educators, and the public at large—a clear picture of a school's status and growth. Therefore measures should communicate how they support college and career preparedness in a way that is easily understood by noneducators and educators alike.

The a–g subject requirements may be one of the more familiar measures of those under consideration for inclusion in the college and career indicator. The a–g subject requirements have high visibility and are very closely aligned to California's graduation requirements. The concept of completing a course sequence is familiar to most individuals who have earned a high school diploma and may be especially salient for individuals who have graduated or completed coursework toward a postsecondary

degree. However, most laypersons are probably not aware of the specifics of what a–g entails.

It is likely that many stakeholders, although not all, are aware that the schools with grades 7–12 are required to provide opportunities for students to acquire entry-level employment skills in an industry upon high school graduation (Section 51228). However, fewer may know that the state encourages districts to integrate academic and career skills and incorporate applied learning across disciplines. Because of this potential knowledge gap, some stakeholders may view a–g and CTE as distinct pathways without overlap, forcing students to make course-taking choices as early as middle school, choices that likely limit future options. Many eighth graders lack knowledge about determinants of success in particular pathways (ACT, 2007). A state implementing an accountability system that includes course-taking behavior would benefit from the public understanding the possibility that any given student can experience and benefit from both systems. Clear explications of distinct and corresponding student benefits of a–g and CTE would prove useful. States can expect stakeholders to become increasingly aware of generalized employability certificates such as the National Career Readiness Certificate, which is desirable for being industry-recognized, portable, and having the ability to add additional levels of demonstrated preparedness (ACT, 2011).

A–G subject requirements:	Strong	
CTE course pathway:	Strong	
Integrated course pathway:	Moderate	Category: Strong

B3. Instructional Sensitivity

In order for the Academic Performance Index to provide a valid description of school quality, its component parts must measure content, skills, and competencies that are taught and learned in schools. This criterion addresses not just the validity of the accountability measure but also the actionability of a college and career indicator.

Satisfying the a–g subject requirements and completing a CTE course pathway are direct measures of the content, skills, and competencies taught and learned in school. Some courses that meet a–g and CTE requirements could be taught outside of a student's school on a college campus, through online platforms, or at industry sites. However, the majority of courses in both pathways will be taught within a student's school, making the inclusion of these course-taking behaviors highly relevant as a school-level indicator.

A–G subject requirements:	Strong	
CTE course pathway:	Strong	
Integrated course pathway:	Strong	Category: Strong

B4. Emphasis on Student Performance

The legislative charge to California's school accountability system prioritizes educational outcomes over inputs. As important as it is to account for different features

of quality schooling (e.g., teachers, instructional resources, curriculum, and school organization), this evaluative criterion looks at the extent to which potential component measures of the college and career indicator emphasize student performance.

Course-taking behavior can measure student performance regardless of where a–g or CTE courses are taught. Satisfying the requirements of the a–g subject requirements, a CTE course pathway, or both requires individual students to not only complete multiple yearlong courses, but also earn a grade C or higher in all required courses.

A–G subject requirements:	Strong	
CTE course pathway:	Strong	
Integrated course pathway:	Strong	Category: Strong

C. System Utility

Measures to be included in an accountability system have greater utility if they add minimal or no burdens to the educational system, yet include as many students as possible. The measures also are most useful when they apply to various postsecondary pathways.

C1. Minimal Burden

Minimizing the burden of component measures of the college and career indicator means constraining the time and cost of implementation and data-collection processes to the fullest extent possible. This criterion considers direct and indirect effects (e.g., time needed to take a test and instructional time devoted to test prep) and the effects on students, educators, administrators, and the system as a whole.

Students in schools that offer a full array of courses that meet a–g subject requirements face minimal burdens because of the similarity of those courses to graduation requirements (a–g requires one more year of English, mathematics, and a language other than English). Similarly, the burden for students in a CTE pathway consists of the time it takes to complete the three- to four-course sequence. This burden is partially minimized by the fact that an increasing number of CTE courses can fulfill a–g subject requirements. A key advantage of a course-taking behavior measure is that no fees or additional time outside regular school hours are required to complete these requirements, beyond normal study time.

The burden to school districts will also be minimal in comparison to other measures considered for inclusion in the college and career indicator. Occasionally schools will be required to submit courses to University of California Office of the President for evaluation. This burden will increase as more CTE courses become a–g approved, which seems likely given that the number of CTE courses a–g approved has increased fourfold since 2003. If additional course evaluation requirements are instituted, schools and districts may face additional burdens. Finally, schools that need to expand and staff new a–g or CTE courses to create equal opportunities for students will face larger burdens than schools already offering sufficient a–g and CTE courses.

EPIC analyzed data from 1,111 high schools offering CTE, finding that on average CTE accounted for approximately 12 of 71 courses (17%) offered per school. Both opportunity-to-learn metrics for schools (i.e., student-CTE course ratio and percentage of CTE completers) revealed wide variation, but correlated significantly to Academic Performance Index. It seems that higher-functioning schools enhance CTE access.

Approximately 80 high schools use the UC Transcript Evaluation Service (TES), a software program that provides reports on individual student progress toward completing the a–g subject requirements. The TES costs nothing to schools that have the necessary computer capabilities, but only a certain number of schools can participate depending on the size of the UC budget. The TES is currently in revision and expansion mode. Schools are expected to pay a small per-student fee beginning in February of 2015. The cost to UC or individual schools that pay for the service may prohibit its large-scale use.

Students, administrators, and counselors can use this information to create effective academic plans for students and to evaluate school-level enrollment patterns to improve efficient offerings of a–g courses. The TES could potentially minimize the administrative burden for participating schools while also expanding student access to a–g courses through efficient course offerings. For example, a pilot study conducted by the College and Career Academy Support Network at UC Berkeley found that the TES increased the proportion of students in grades 9 and 10 on pace to complete the a–g subject requirements (Sanchez et al., 2009). Additionally, the University of California Office of the President reports that schools using the TES increased their a–g completion rates on average by 7.8% after two years, and by 35.7% after four years (University of California Office of the President: TES, 2014).

The California Department of Education will be given the responsibility to ensure the reliability and validity of course grades, which depends upon improving University of California Office of the President's course evaluation system to ensure consistent course content and quality. Additionally, follow-up studies of post-high school performance will be necessary to provide high schools with the information necessary to improve courses and demonstrate a connection to postsecondary success. Many a–g and CTE courses do not have such structures in place. This may cause additional school and district burdens by requiring schools to improve course quality based on student postsecondary performance. Currently, data on CTE course completers is collected from CALPADS, Cal-Pass+, the Institute of Evidence-Based Change, and individual school districts. Additional burdens to the California Department of Education will include standardizing data collection processes on CTE course pathway completers for consistency, accuracy, and reliability.

Many of the systems needed to incorporate course-taking behavior into the college and career indicator are already in place. For instance, University of California Office of the President already evaluates a–g and some CTE courses. Expanding this evaluation system could require resources for a sustained period of time. However, computerized systems exist allowing educators to create syllabi aligned to content

standards and receive instant feedback on whether the course adequately covers the necessary standards. The fixed cost of such a system would be significant, but maintaining it would require minimal resources. This type of system would also standardize content across schools more effectively, which would lead to increased stability of course pathway completions.

A–G subject requirements:	Strong	
CTE course pathway:	Strong	
Integrated course pathway:	Moderate	Category: Strong

C2. Student Coverage

The Academic Performance Index Guiding Principles state that the Academic Performance Index should include as many students as possible in each school and district. This inclusion principle was cornerstone to an accountability system based entirely on universal measures (e.g., all students must take state assessments including populations requiring testing accommodations). The proposed college and career indicator is by necessity composed of conditional measures because not all students can be compelled to go to college, nor would it be desirable for all students to do so. Students and their parents retain the right to choose which path makes the most sense for them; college is only one option among many. In addition, students can demonstrate preparedness through an array of measures that are linked empirically to postsecondary success but that address different knowledge, skills, and aspirations. This evaluative criterion gives preference to scaled or scalable measures over local and unique ones.

Approximately 160,131 or 32% of California's high school seniors satisfied the a–g subject requirements in 2013. That same year, 127,322 or approximately 26% of high school seniors completed CTE pathways, assuming all students who finished CTE pathways did so during their senior years. Access to both the a–g subject requirements and CTE course pathways are nearly ubiquitous in California high schools pursuant to Education Code 51228, and as separate measures, both course-taking pathways could potentially cover all graduating seniors. Most students who attend high schools that do not offer CTE courses can typically access CTE content at nearby schools or online. However, students pursuing career or two-year college pathways have little incentive to complete the a–g subject requirements and, conversely, students pursuing the four-year college pathway have little incentive to complete a CTE course pathway. A measure that places the highest Academic Performance Index value on completing both the a–g subject requirements and a CTE course pathway creates an incentive for schools to encourage students to gain valuable college and career training in a way that will benefit them in the future, regardless of their chosen postsecondary pathway.

Furthermore, a statewide plan providing greater standardization to course-taking behavior would prove beneficial to more transient students. Schneider, Swanson, and Riegle-Crumb (1998) found lower placement in course sequences for students making nonroutine school changes. Inferentially, if course-taking behavior became more routinized, students moving across or between districts would have fewer educational interruptions than they may experience currently.

An integrated course pathway measure that gauges the proportion of students who pursue college and career postsecondary pathways simultaneously has the potential to cover all graduating seniors in California. Separate measures for each pathway could also cover all graduating seniors but may encourage student tracking and could also create perverse incentives for schools by limiting students to pursuing the college *or* career pathway. Additionally, standardizing course content through an effective course evaluation system could improve student coverage by creating fewer educational interruptions for students whose families move often.

A–G subject requirements:	Moderate	
CTE course pathway:	Moderate	
Integrated course pathway:	Weak	Category: Moderate

C3. Various Postsecondary Pathways

The last criterion is less an evaluation of a measure than a categorization to inform more global decisions about the Academic Performance Index. A college and career indicator must include component measures that collectively or individually recognize a diverse set of postsecondary pathways. Thus, this criterion evaluates the extent to which a measure assesses college- and career-going pathways simultaneously.

The a–g subject requirements are relevant to the college-going pathway, and within that pathway the emphasis is on four-year institutions. The a–g subject requirements are designed to ensure that students "have attained a body of general knowledge that will provide breadth and perspective to new, more advanced (university) study" (University of California Office of the President, 2014). Conversely, the CTE course pathway completion is geared more toward the career-going pathway, although modest evidence suggests that career academies have positive effects on students matriculating to community college or four-year institutions (Kemple 2004; Kemple & Willner, 2008; Center for Advanced Research and Technology, 2011). However, an integrated course pathway measure that produces incentives for schools to encourage students to complete both the a–g subject requirements and a CTE course pathway will be relevant to both the college and career postsecondary pathways.

A–G subject requirements:	Moderate	
CTE course pathway:	Moderate	
Integrated course pathway:	Strong	Category: Moderate

Conclusion

In summary, the evidence suggests that course-taking behavior is a critical component of college and career preparedness by: a) having one of the strongest research bases of all potential college and career preparedness measures under consideration, b) providing tangible educational and career value to students, and c) being a pure measure in terms of the content, skills, and competencies taught in school and student performance. Fair comparisons are complicated by the low a–g completion

rate for Hispanic, African American, American Indian, and Pacific Islander students, and students eligible for free and reduced-priced lunch. Teacher and resource inequalities across low-income, low-performing, and high-minority schools also create fairness concerns. Tables 3, 4, and 5 summarize the evaluative criteria ratings.

Table 3. Technical Quality Ratings

Course-taking Behavior	A. Technical Quality		
	A1	A2	A3
A–G subject requirements	Strong	Moderate	Moderate
CTE course pathway	Moderate	Moderate	Moderate
Integrated course pathway	Strong	Strong	Moderate
Category	Strong	Moderate	Moderate

Table 4. Stakeholder Relevance Ratings

Course-taking Behavior	B. Stakeholder Relevance			
	B1	B2	B3	B4
A–G subject requirements	Strong	Strong	Strong	Strong
CTE course pathway	Moderate	Strong	Strong	Strong
Integrated course pathway	Strong	Moderate	Strong	Strong
Category	Strong	Strong	Strong	Strong

Table 5. System Utility Ratings

Course-taking Behavior	C. System Utility		
	C1	C2	C3
A–G subject requirements	Strong	Moderate	Moderate
CTE course pathway	Strong	Moderate	Moderate
Integrated course pathway	Moderate	Weak	Strong
Category	Strong	Moderate	Moderate

Many of the systems necessary to effectively incorporate a course-taking behavior measure into the college and career indicator are already in place and most necessary data are currently collected, although improvements to the CTE completion data-collection process are needed. Improving the University of California Office of the President course evaluation system and creating an integrated course pathway measure has the potential to move many of the evaluative criteria ratings from moderate to strong. For example, requiring all CTE courses to be evaluated and requiring all a–g and CTE courses to demonstrate alignment to Common Core or the CTE Model Curriculum standards would strengthen the stability of a course-taking behavior measure. An integrated course pathway measure would simultaneously increase the rigor of both college and career pathways by exposing students and educators to the strengths of both pathways. This type of measure could also create incentives for cross-disciplinary partnerships between core academic and CTE educators, stressing development of essential metacognitive skills, which are facilitated best in

transdisciplinary contexts and have been discussed in an earlier white paper in this series.

Integrated course pathways are burgeoning in education. The IB Career-Related Certificate (IBCC) was introduced in 2013. It connects its established university preparatory Diploma Programme with a career pathway accredited at the national, state, or local level. For example, a student might pursue Diploma Programme coursework in biology and a language other than English while also pursuing a health occupations pathway, in order to increase her future employability by enhancing both professional and linguistic competencies. Students must take at least two Diploma Programme courses and can take as many as four in addition to their career pathway to complete the IBCC. However, only schools already authorized to offer Diploma Programme coursework can add the IBCC. Four California high schools (Claremont, Granite Bay, San Jose High Academy, and Walnut) are among the 53 public schools in the US that offer the IBCC. Although instituting this program on a large scale creates its own set of problems, IBCC presents an innovative example that California could learn from and improve upon.

Additionally, an integrated course pathway measure could have unexplored positive social consequences, breaking down barriers between core academics and CTE. An integrated approach might also stimulate examinations of opportunity-to-learn disparities. Ultimately, an integrated measure would likely facilitate school cohesion, which would benefit students directly and might indirectly benefit a–g and CTE educators who would have increased incentives and opportunities to create synergies among curriculum offerings.

References

ACT. (2007). *Rigor at risk: Reaffirming quality in the high school core curriculum.* Iowa City, IA: Author.

ACT. (2011). *Defining credentials for the public workforce system: ACT policy brief*. Iowa City, IA: Author.

Adelman, C. (1999). *Answers in the tool box: Academic intensity, attendance patterns, and bachelor's degree attainment*. Washington, DC: U.S. Department of Education.

Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college.* Washington, DC: U.S. Department of Education.

Bishop, J. H., & Mane, F. (2004). The impacts of career-technical education on high school labor market success. *Economics of Education Review*, *23*(4), 381–402.

CAL. EDC. CODE § 51228: California Code - Section 51228.

California Department of Education. (2013). *California high school career technical education courses meeting University of California "a–g" admission requirements for 2012–13*. Sacramento, CA: Author.

Carroll, S. J., Krop, C., Arkes, J., Morrison, P. A., & Flanagan, A. (2005). *California's K-12 public schools: How are they doing?* Santa Monica, CA: RAND Corporation.

Catterall, J. S. (2009). *Doing well and doing good by doing art.* Los Angeles, CA: I-Group Books.

Center for Advanced Research and Technology. (2011). *A model for success: CART's Linked Learning program increases college enrollment.* Clovis, CA: Author.

Choi, K., & Shin, E. (2004). *What are the chances of getting into a UC school?: A look at the course-taking patterns of high school students for UC admissions eligibility.* Los Angeles, CA: University of California Los Angeles Center for the Study of Evaluation.

Dayton, C., Hester, C. H., & Stern, D. (2011). *Profile of the California Partnership Academies, 2009-10*. Berkeley, CA: University of California.

DeAngelo, L., Franke, R., Hurtado, S., Pryor, J. H., & Tran, S. (2011). *Completing college: Assessing graduation rates at four-year institutions*. Los Angeles, CA: University of California Los Angeles Higher Education Research Institute.

Educational Policy Improvement Center. (2014). *National Assessment of Educational Progress grade 12 preparedness research project: College course content analysis. Draft Report.* Eugene, OR: Author.

Finkelstein, N., Fong, A., Tiffany-Morales, J., Shields, P., & Huang, M. (2012). *College bound in middle school and high school? How math course sequences matter.* Sacramento, CA: The Center for the Future of Teaching and Learning at WestEd.

Finkelstein, N. D., & Fong, A. B. (2008). *Course-taking patterns and preparation for postsecondary education in California's public university systems among minority youth.* (REL 2008-No. 035). Sacramento, CA: Regional Educational Laboratory West.

Foster, J. C., & Pritz, S. G. (2006). The certification advantage. *Techniques, 81*(1), 14–20.

Goodman, J. (2012). *The labor of division: Returns to compulsory math coursework* (RWP12-032). Cambridge, MA: Harvard University John F. Kennedy School of Government.

Kemple, J. J. (2004). *Career academies: Impacts on labor market outcomes and educational attainment.* New York, NY: MDRC.

Kemple, J. J., & Willner, C. J. (2008). *Career academies: Long-term impacts on labor market outcomes, educational attainment, and transitions to adulthood.* New York, NY: MDRC.

Knapp, L. G., Kelly-Reid, J. E., and Ginder, S. A. (2011). *Enrollment in postsecondary institutions, fall 2009; graduation rates, 2003 & 2006 cohorts; and financial statistics, fiscal year 2009* (NCES 2011-230). Washington, DC: U.S. Department of Education, National Center for Education Statistics.

Lekes, N., Bragg, D., Loeb, J. W., Oleksiw, C. A., Marszalek, J., Brooks-LaRaviere, M.,…Hood, L. K. (2007). *Career and technical education pathway programs, academic performance, and the transition to college and career.* St. Paul, MN: University of Minnesota National Research Center for Career and Technical Education.

Levine, P. B., & Zimmerman, D. J. (1995). The benefit of additional high-school math and science classes for young men and women. *Journal of Business & Economic Statistics, 13*(2), 137–149.

Long, M. C., Conger, D., & Iatarola, P. (2012). Effects of high school course-taking on secondary and postsecondary success. *American Educational Research Journal, 49*(2), 285–322.

Maxwell, N. L., & Rubin, V. (1997). *The relative impact of a career academy on post-secondary work and education skills in urban, public high schools.* Berkeley, CA: University of California National Center for Research in Vocational Education.

O'Connell, J., & Woodruff, D. (2008). *2008-2012: California state plan for career technical education*. Sacramento, CA: California Department of Education.

Oakes, J., & Saunders, M. (2004). Education's most basic tools: Access to textbooks and instructional materials in California's public schools. *The Teachers College Record, 106*(10), 1967–1988.

Rose, H., & Betts, J. R. (2004). The effect of high school courses on earnings. *Review of Economics and Statistics, 86*(2), 497–513.

Sanchez, J., Kaufman, G., Morales, C., Hayes Melish, M., Clark, P., Dayton, C., Stern, D., &

Tidyman, S. (2009). Using Better Information to Help Reduce Inequality in College Access: Preliminary Results of a Pilot Project. Berkeley, CA: College and Career Academy Support Network, Graduate School of Education, University of California, Berkeley.

Schneider, B., Swanson, C. B., & Riegle-Crumb, C. (1997). Opportunities for learning: Course sequences and positional advantages. *Social Psychology of Education, 2*(1), 25–53.

Schwartz, M. S., Sadler, P. M., Sonnert, G., & Tai, R. H. (2009). Depth versus breadth: How content coverage in high school science courses relates to later success in college science coursework. *Science Education*, *93*(5), 798–826.

Trusty, J., & Niles, S. G. (2003). High-school math courses and completion of the bachelor's degree*. Professional School Counseling, 7*(2), 99–107.

University of California Office of the President. (2014). A–G subject requirements. Retrieved from http://www.ucop.edu/agguide/a-g-requirements/

University of California Office of the President: Transcript Evaluation Service (2014). How TES affects student success and educator resources. Retrieved from http://www.transcriptevaluationservice.com/benefits/outcomes.html

WestEd & EPIC. (2013). *National Assessment of Educational Progress grade 12 preparedness research project job training programs curriculum study: Final report.* San Francisco, CA, and Eugene, OR: Authors.