PPIC | PUBLIC POLICY INSTITUTE OF CALIFORNIA

Stackable Credentials in Career Education at California Community Colleges

Technical Appendices

CONTENTS

Sarah Bohn and Shannon McConville

With research support from Bonnie Brooks and Sophie McGuinness

Supported with funding from the ECMC Foundation, the James Irvine Foundation, and the Sutton Family Fund

Appendix A. Data and Sample Construction

Data sources

The data used in this report come from the California Community College Chancellor's Office (CCCCO). The Chancellor's Office Management Information System (COMIS) is a longitudinal dataset that includes information on all students enrolled in colleges across the California Community College system. This dataset includes detailed information on student characteristics, including demographics, measures of economic and academic disadvantage, and disability, along with course enrollment, financial aid receipt, and award completion. We have these records for all students between the fall term of 1993 and the spring term of 2017.

The data system also contains information on the awards or credentials that a student completes.[1] We classify all awards that students earn in the system into three categories—short-term certificates, long-term certificates, and associate degrees. Short-term and long-term certificates are defined based on the length of time, measured in terms of units and assuming full-time course loads, it takes to complete the degrees. Short-term certificates take less than 1 year to complete and include certificates requiring less than 30 units. Long-term certificates are defined as those requiring between 1 and 2 years to complete and include certificates requiring 60 or more units and those requiring 30-59 units. Associate degrees can be either associate of art or science and typically take 2 or more years to complete.

All courses and awards include information that designates a specific field of study called a Taxonomy of Program (TOP) code. The TOP system of numerical codes is used to collect and report information on programs and courses in different colleges throughout the state that have similar outcomes. We use TOP codes to identify career education awards. The CCCCO designates all career education or vocational programs based on the 6-digit TOP code.

The TOP codes were designed to aggregate information about programs and all courses and awards are coded with a 6-digit TOP code. The first two digits of the six-digit TOP denote the discipline and is used to define our broad career education areas which include Business and Management (05), Information Technology (07), Engineering (09), Family and Consumer Sciences (13) and Public and Protective Services (21). The first four digits are intended to denote a sub-discipline (e.g. 1305: Child Development/Early Childhood Education), and the entire six digits denote a specific field of study (e.g. 130580: Child Development Administration and Management).

Defining Stackable Credential Features

In order to systematically examine stackable credentials, we developed a strategy that would allow us to identify career education programs based on interrelated credentials they offer and to classify those credential features. Although programs are intuitive, akin to college departments like culinary arts, automotive technology, information technology, etc., no statewide data source tracks programs in this way. The TOP code contained in COMIS is both too broad and too detailed. A sub-discipline (4-digit TOP) typically contains multiple programs and sets of credentials that have no overlapping course requirements. The field of study (6-digit TOP) is too detailed, with credentials in different fields of study actually closely related in terms of course requirements and

[1] One caveat in our research pertains to the potential underreporting of short-term certificates that are not approved by the Chancellor's office. These 'local' certificates are college- and department-specific certificates less than 12 units. Because the CCCCO does not require colleges to report local certificates in COMIS—although many do—non-reported local certificates are not included in our analysis.

career options. Furthermore, there is a lot of variation across colleges and program areas in what may or may not be offered in a sub-discipline or field of study.

To appropriately identify career education programs and classify students according to their program awards, we first attempted to connect information available from COMIS on the types of awards students earn (i.e. TOP codes and credential length) to the inventory of programs and courses available from the Chancellor's office. Unfortunately that approach was not workable due to the high levels of mismatch—there were too many credentials in COMIS that did not have a match to the inventory and vice-versa.

In the end, we determined the best way to identify and describe programs according to their stackable pathways would require a detailed scan of college course catalogs that would allow us to explicitly connect credentials based on overlapping course requirements and other available descriptors of programs and credentials. To employ this more qualitative approach, we also needed to identify a subset of colleges on which to focus our scan in order to make the task more manageable. At the same time, we wanted to ensure that the colleges we scanned had career education programs that had enough different types of credentials available to make stackable credentials a possibility.

We selected a group of colleges to conduct in-depth catalog scans for each of the five focal career education disciplines based on the number of awards they conferred by credential length (short-term, long-term, associate). First, we sorted all schools by the number of certificates (long-term and short-term) and also associate degrees they conferred in school year 2015-16 and selected colleges with the highest number of each type of credentials that cumulatively added up to 50% of the total awards systemwide that were conferred in that career education discipline. In cases where the number of schools needed to encompass 50% of associate degrees was close to that of certificates, we chose whichever had the greater number of schools. We find that this selection method organically provided a large and diverse sample of programs with stacking potential. Using this method, across all disciplines we identified 64 community colleges overall to be scanned and between 25 and 32 colleges for each career education discipline (business, IT, engineering, family/consumer science, and public/protective services).

Second, from the selection of colleges identified for the scan, we used available information from COMIS and the CCCCO program inventory to enumerate all of the specific fields of study available in the career education discipline based on 6-digit TOP code and the program names and descriptors provided in the inventory. The TOP codes were necessary so that we could link the scan information back to the student-level COMIS data and the program names assisted us in finding the programs of interest in the course catalogs. With our scan information in college catalogs to answer questions aimed to identify the differing degrees to which a program fulfills the characteristics of three types of pathways to stacking credentials:

TABLE A1

Stackable pathway definitions and features

Pathway type	Definition	Features
Progressive	Students can upgrade from lower-level credentials to higher-level credentials (vertical) by completing additional coursework within the same program	Are there smaller credentials that can be upgraded to higher-level credentials (certificate or associate) by adding additional units in the CTE area?
		If yes, is there a sequence that involves only certificates, not associate degrees?
		Does the catalog explicitly state there are levels or stages within a program (i.e. using terms like beginner, intermediate, advanced OR I, II, III in program titles)
Lattice	Students complete a group of courses that serve as a "Launchpad" to multiple same-level (horizontal) and/or higher-level (vertical) credentials	Are there 3 or more degrees and certificates that share a core group of (2+) classes?
		Is the shared group of courses called out (identified as a "core") in the catalog to indicate that it can lead to multiple credentials?
		Even if the core is not directly labeled "core," does the group of core courses alone earn the student either a local certificate or a certificate of achievement?

After coding each field of study using the guiding questions, programs that share certain features (and subsequently share stacking potential) we assign a unique code called the Internal Control Number (ICN) to programs that share coursework. The ICN is intended to identify sequences of credentials by linking programs that share coursework across six-digit TOP codes in a given college. In this way we can connect multiple fields of study within a discipline that could be part of stackable credential pathway. The definition of the ICN is listed below.

ICN = College ID + Two-Digit TOP Code + First-Degree Connection + Second-Degree Connection

To determine if programs share either a first-degree or second-degree connection we ask the following questions. For the first-degree connection: at least 2 course requirements come from other programs? If so, assign the same digit to programs that overlap by at least 2 courses. For the second-degree connection: are programs themselves pieces of the same program sequence (and/or have 3-4 classes that overlap)? If so, assign the same digit to programs that overlap by 3-4 classes.

In the final step, we link the information on pathway features at the ICN level (8-digit code that includes the 1st and 2nd degree of connection) to the COMIS data by college and 6-digit TOP code. Table A2 provides information on the pathway features for each of the two stackable pathway types we define at the ICN 8-digit level as it provides the most granular detail on pathway characteristics. In our main analysis, we use the ICN 7-digit code to determine if students stack additional credential along a program pathway to allow for a more broad definition of potential connection between programs.

TABLE A2

Characteristics of programs across career education disciplines

Pathway characteristics	Business	Engineering	Public and protective services	Information technology	Family and consumer sciences	Total
Progressive						
Potential to upgrade credentials	106 (82%)	137 (87%)	66 (71%)	41 (56%)	95 (90%)	445 (80%)
Certificate-only paths	72 (56%)	82 (52%)	20 (22%)	26 (36%)	64 (61%)	264 (47%)
Explicit credential sequence	18 (14%)	10 (6%)	4 (4%)	7 (10%)	27 (25%)	66 (12%)
Lattice						
Common set of course requirements for multiple credentials	101 (79%)	58 (37%)	48 (52%)	28 (39%)	63 (60%)	298 (54%)
Explicit core/launchpad	14 (11%)	3 (2%)	4 (4%)	5 (7%)	1 (1%)	27 (6%)
Core-alone earns credential	0 (0%)	7 (4%)	1 (1%)	4 (6%)	6 (6%)	18 (3%)
Total programs identified	**129**	**157**	**93**	**72**	**105**	**556**

Sample Construction

We build our sample universe from the COMIS data file that records the awards students earn. For the purposes of this report, we restrict our sample to those students who earned their first observed award (at least since 1993) within the community college system between the years 2000 and 2014—so that we can observe students for at least three years following the completion of their first community college award. We further restrict our sample to students who have an SSN (scrambled and de-identified in our data extract) recorded as an identifier. Each community college assigns school-level student identification numbers, but these are not unique across the entire system. Restricting our sample to students with an SSN as an identifier allows us to track students across multiple colleges so we have a complete picture of their coursework and credentials.

For our examination of the broad trends in career education credentials presented in the first section of the report, we include all students age 18 to 54 who earn their first community college credential between school years 2000–01 and 2013–14. We designate students earning career education credentials based on the designation of vocational programs provided in the Taxonomy of Programs (TOP) manual 6th Edition (California Community Colleges, Academic Affairs Division, July 2013). Table A3 provides descriptive statistics across different student groups—including all students who earned a credential regardless of if it was in career education, all students who earned any career education credential as their first community college award with breakdowns by the level of their first credential.

TABLE A3

Sample means by group

	All students	Any career education, 1st award	Highest level of 1st career education award		
			Associate degree	Long-term certificate	Short-term certificate
Total	**1,131,711**	**512,377**	**222,241**	**95,205**	**194,931**
Age at first award					
Mean	27.6	30.4	29.6	31.1	31.0
18-24	52.2%	36.5%	38.7%	32.9%	35.9%
25-29	17.7%	20.1%	22.1%	20.2%	17.9%
30-34	10.0%	13.3%	13.4%	14.2%	12.8%
35-39	7.0%	10.0%	9.4%	10.6%	10.4%
40-54	13.1%	20.0%	16.3%	22.1%	23.1%
Sex					
Male	40.5%	43.2%	38.5%	45.8%	47.3%
Female	59.5%	56.8%	61.5%	54.2%	52.7%
Race/Ethnicity					
White	30.1%	30.6%	42.8%	41.3%	42.2%
Latino	15.9%	16.1%	28.7%	30.8%	32.5%
African American	7.1%	7.4%	6.6%	8.9%	7.5%
Asian/Pacific Islander	42.9%	42.3%	18.5%	15.0%	14.0%
Other/Multi/Missing	4.0%	3.6%	3.4%	4.0%	3.7%
Citizenship status					
Citizen	86.6%	84.9%	83.9%	84.9%	86.1%
Non-Citizen	9.6%	10.9%	11.3%	11.2%	10.4%
Unknown	3.8%	4.1%	4.8%	3.9%	3.5%
Highest level of education					
No high school diploma	3.7%	4.4%	2.8%	4.9%	5.9%
High school diploma/GED	78.8%	74.2%	72.3%	78.1%	74.4%
Associate degree	7.8%	7.1%	12.2%	3.3%	3.1%
Bachelor's degree or higher	4.3%	8.3%	6.9%	8.5%	9.9%
Other/Missing	5.4%	6.0%	5.8%	5.3%	6.7%
Markers of disadvantage					
Low income (Pell or age 25+ and BOGW)	51.1%	53.5%	56.7%	54.8%	49.3%
Limited English proficiency	8.2%	10.0%	9.3%	9.8%	10.8%
Academic disadvantage	63.1%	62.1%	64.1%	61.8%	60.0%
Student with disabilities	7.6%	8.1%	7.1%	9.1%	8.8%
Ever CalWORKs	4.6%	6.4%	5.4%	7.4%	7.0%
Markers of ability					
Ever developmental math or English	43.7%	36.0%	39.6%	31.4%	34.2%
Ever transfer math or English	51.4%	28.8%	43.9%	15.1%	18.4%
GPA	2.07	2.13	2.15	2.13	2.09
Financial aid					
Ever BOG Waiver	60.9%	60.3%	63.3%	61.2%	56.4%

	All students	Any career education, 1st award	Highest level of 1st career education award		
			Associate degree	Long-term certificate	Short-term certificate
Ever Pell	42.1%	41.7%	44.3%	42.4%	38.3%
Ever Cal Grant B	12.7%	12.2%	13.9%	11.8%	10.5%
Ever Cal Grant C	2.2%	3.6%	3.8%	4.8%	2.9%
Received Pell after first award	24.5%	26.3%	23.8%	27.8%	28.4%
Post First Award					
Transfer to four-year university, 3 years	41.3%	18.8%	32.8%	6.4%	8.9%

Source: Authors' calculations based on COMIS data. Includes students age 18-54 at the time of their first award earned between 2001 and 2014 school years. We also exclude a small group of students (7,043) who earned both career education and non-career education credentials as their first award in the community college system and the non-career education credential was of a higher level than the career education credential.

Limitations

There are limitations to our data and analytic approach. First, our pathway analysis relies on the subset of colleges included in our pathways database and is not necessarily representative of the whole California community college system. While we sought to include colleges that conferred a large number of career education credentials and those with different types of credential lengths that could support stackable pathways, the colleges not included could very well have different program features. In addition, only a small percentage of programs we do include in our sample explicitly define their pathways (12% of progressive pathways and 6% of lattice pathways). While we use college catalog information to flag features within programs that signal progressive or lattice pathway design, colleges may not have intended to design a program based on the features and definitions we impose.

Furthermore, the college catalog information we used for our scan to categorize programs and their stackable pathway features is limited to the 2016-2017 academic year, which we use to then retroactively apply to the programs in previous academic years. Our main models present findings from 2010 forward, but it is possible that the stackable features we identified based on 2016-17 catalog information were not in place in the earlier years.

Finally, colleges are not required to report short-term certificates that are not approved by the Chancellor's Office to COMIS—although many do. Our catalog scan and pathways database include these local certificates, but to the extent that we do not observe them in the student-level COMIS data, we are likely under-estimating the number of students who earn short-term credentials as well as those that complete a stackable pathway that starts with local certificate—sometimes referred to as Certificates of Accomplishment.

Appendix B. Analysis of Student Outcomes

Empirical Strategy

Our analysis is primarily descriptive, with the goal of quantifying the prevalence of stacking within the community college system and identifying correlates of stacking credentials. As the report describes, we focus on students whose first award in the system is a short-term career education credential. For these students, we track whether, through the period of study, they earn:

- Any other credential
- Any other credential in the same career education discipline as the first
- Any other credential in the same career education program (as identified with ICN7/ICN8 in our pathway database)

The last constitutes pure "stacking" in this analysis, as it indicates accumulating skills/credentials within a given career pathway.

TABLE B1

Students earning multiple credentials by the level of their first career education credential

	Highest level of 1st career education credential		
	Short-term certificate	Long-term certificate	Associate degree
Any other credential			
Within 3 years of first	27.7%	20.3%	8.2%
Within 6 years of first	31.9%	24.4%	9.6%
Another credential in the same discipline (TOP2)			
Within 3 years of first	20.1%	15.3%	4.2%
Within 6 years of first	22.5%	17.8%	4.7%
Total students, 3 year	194,931	95,205	222,241
Total students, 6 year	149,413	74,668	161,329
Another credential in the same pathway program (ICN7)			
Within 3 years of first	23.8%	18.7%	5.1%
Total students in colleges in pathway database, 3 year	73,433	26,174	45,939

SOURCES: Author's calculations from COMIS data and pathway database.

NOTES: Restricted to students 18 to 54 at the time of their first career education credential. The 3-year measures include students who earned their first award between school years 2000–01 and 2013–14 and the 6-year measures include students who earned their first award between school years 2000–01 and 2010–11.

Next, to describe the characteristics of students according to their likelihood of stacking, we examine a number of socioeconomic characteristics, as defined in Table B2.

TABLE B2

Variable definitions

Variable	Description
Outcomes	
Stack in same CTE program (ICN7)	This variable is 1 if a student earned an additional award within three years of earning their first award
Stack to higher credential	This variable is 1 if a student earned a higher-level award than the award they first earned
Student demographic attributes (COMIS)	
Sex	Categorical variables for female and unknown sex, with male as the reference category
Race/Ethnicity	Categorical variables for Latino, African American, Asian-Pacific Islander, other race (includes two or more races, Native American) and unknown race. White is the reference category
Citizenship status	Categorical variable for non-citizen (permanent resident, temporary resident, refugee/asylee, F-1 or M-1 student visa, other status) and unknown citizenship. US citizen is the reference category
Age	Continuous variable for the age of a student upon receiving their first award between 2001 and 2014. Range is between 16 and 70 years old
Student academic preparedness proxies (COMIS)	
Highest level of education at first term	Categorical variable indicating the highest level of education completed in the term that the student completes their first career education award. Categories include less than high school (includes adult ED and GED), associate degree, or bachelor degree or higher. High school graduate is the reference category
Disability status	This variable is 1 if a student was ever recorded as having at least one primary disability during their academic career in the community college system. Primary disabilities include mobility, visual, hearing, or speech impairment; intellectual, learning, or mental health disability; brain injury, ADHD, autism spectrum or other.
Limited English proficiency	This variable is 1 if a student was either enrolled at some time in their academic career in a basic skills English as a Second Language (ESL) course or was identified as needing ESL services. This is a derived variable created by the CCCCO.
Academically disadvantaged	This variable is 1 if a student had enrollment or been flagged as needing basic skills instruction or was reported on academic probation or dismissal at least once in their academic career. This is a derived variable created by the CCCCO.
Student socioeconomic status (COMIS)	
Low-income	This variable is 1 if a student ever received a Pell grant or is over age 25 and received a Promise Grant (formerly called a Board of Governor's (BOG) waiver) sometime during their academic career at the community college system.
Ever CalWORKs	This variable is 1 if a student was ever identified as receiving CalWORKs at any time during their academic career at the community college system.
Markers of ability (COMIS)	
Ever developmental math or English	This variable is 1 if a student ever enrolled in a developmental math or English course within two years of earning their first award
Ever college math or English	This variable is 1 if a student ever enrolled in a college-level math or English course within two years of earning their first award
GPA	Continuous variable indicating a student's grade point average in the two year period prior to their earning their first career education credential.
Pathway characteristics (pathway scan database)	
Number of credentials offered	Continuous variable indicating the number of credentials that a given program offers
Associate degrees offered	Continuous variable indicating the percent of credentials a given program offers that are associate degrees in science or arts
Local short-term credentials offered	Continuous variable indicating the percent of credentials a given program offers that are short-term credentials not approved by the CCCCO, also referred to as local certificates
Explicit pathway feature	This variable is 1 if a program is categorized as having either an explicit progressive pathway or a defined launchpad core for lattice.
Pathway feature, but not explicit	This variable is 1 if a program has smaller certificates that can be upgraded to higher level certificates (certificate-only paths) for progressive pathways, or for lattice pathways has at least three credentials that share a core group (2+) of courses.

Variable	Description
Pathway with minimal features	This variable is 1 if a program only has certificates that can be upgraded to associate degrees, often with just the completion of general education requirements or in the case of lattice pathways, no feature.
No pathway features	This variable is 1 if a program has no identified features of either a progressive or lattice pathway.

NOTES: The CCCCO MIS data element dictionary provides a more detailed description of each variable used in our study (CCCCO undated).

Table B3 provides sample means for our analytic sample of short-term certificate earners in career education programs included in our pathways database. The analytic sample is restricted to students age 18 to 54 at the time of their first award, earned in 2010-2014, and excludes students who eventually transferred or who had missing values for the control variables. It is also restricted only to students who completed their first career education award at colleges that were scanned and included in our pathways database.

TABLE B3

Sample means of dependent and independent variables

	All years	2010 forward
	Mean	Mean
Stacking credentials within an ICN	24.1%	27.2%
Gender		
Male	47.4%	51.6%
Female	52.6%	48.4%
Age		
Age at first award	31.1 (9.8)	30.1 (9.7)
Age^2	1060.6 (676.8)	1001.3 (668.8)
Race/Ethnicity		
White	38.3%	36.4%
Latino	36.3%	38.0%
Asian-PI	14.2%	13.5%
African American	7.8%	7.9%
Other/Missing	3.4%	4.2%
Citizenship status		
Citizen	84.4%	87.0%
LPR	11.6%	9.5%
Other/Missing	3.9%	3.5%
Highest level of education		
HS or equivalent	76.1%	79.6%
No HS	6.0%	3.8%
AA	2.8%	2.2%
BA+	8.8%	9.9%
Other/Missing	6.3%	4.5%
Markers of disadvantage		
DSPS	9.0%	9.7%

	All years	2010 forward
	Mean	Mean
Academic disadvantage	63.8%	66.4%
Limited English proficiency	13.5%	11.4%
Pell	41.0%	48.7%
CalWORKs	8.5%	7.3%
Markers of ability		
Developmental Math or English	35.8%	39.7%
Avg. GPA	2.0	2.02
Course characteristics		
Prop. work-based courses	7.0%	8.9%
Prop. evening courses	33.1%	33.5%
Prop. online courses	16.1%	17.8%
Wage return		
Wage return	9.47 (9.49)	8.75 (9.20)
First award: discipline		
Business	16.4%	19.0%
Information technology (07)	4.1%	5.5%
Engineering and industrial technologies (09)	19.1%	23.8%
Family and consumer sciences (13)	34.4%	29.9%
Public and protective services (21)	26.0%	21.8%
First award: school year		
2001	6.0%	
2002	6.1%	
2003	6.8%	
2004	6.2%	
2005	6.9%	
2006	7.5%	
2007	7.4%	
2008	6.9%	
2009	7.6%	
2010	7.0%	18.0%
2011	6.6%	17.2%
2012	7.6%	19.7%
2013	8.8%	22.9%
Number of observations	58,111	22,445

SOURCES: Author calculations from COMIS data.

NOTES: Summary statistics from sample used in model (5) of Table B4, showing all years and main analytic sample years (2010-forward). Standard deviations are included for continuous variables in parentheses.

In order to assess individual characteristics one by one, and to identify the effect of program features ceteris paribus, we estimate a number of linear and fixed effect regression models. These models estimate the relationship between earning a second credential in the same program (same ICN7 code) and individual

characteristics, certain non-design program characteristics, and college, period, and discipline effects. Table B4 provides detailed regression results for the full analysis sample, with alternative specifications and fixed effects.

Model (1) is the simple descriptive model used to calculate odds of stacking credentials across demographic groups and across major programs (see report Figure 9). For parsimony and clarity in creating predicted odds of stacking, not all covariates are included in this initial model. Also, the sample of students is much broader—including those in programs that are in our scan database and whose first award was a short-term certificate.

Models 2 through 5 present full covariates used in our main models, and test alternative specifications with regard to fixed effects and sample criteria. Model (5) is the chosen specification we utilize for all subsequent analyses. To this specification we add covariates of interest on program design, summarized in a subsequent table. For the baseline specification, we include rich student-level characteristics that account for student background and ability, factors strongly correlated with completion, broadly speaking. We also incorporate a handful of program characteristics (aside from stackable design) that may be related to completion—course delivery methods including online, evening, and work-based. In addition we utilize estimates of the wage return with in a 6-digit TOP code level, estimated in Bohn, McConville and Gibson (2016). In theory, a student who earns an initial high-value credential may be less likely to return to stack another credential. These wage returns are themselves results from a student-longitudinal regression model, but are not refined enough to signal wage returns for the specific credential a student earns, rather the program the credential is from.

Lastly, fixed effects for discipline (2-digit TOP code), college, and year, are included to account for the fact that certain colleges or programs may be better at ensuring student completion (or their local industry, labor markets, etc., may provide more or less incentive to complete). Year effects, in particular, may also address the cyclicality of enrollment. We tested alternative fixed effects—more detailed TOP codes and additional interactions, for example—but given our sample size and degrees of freedom we chose specification (5) as our baseline.

TABLE B4

Main linear and fixed effects models of earning a stacked credential in a program within 3 years

Dependent variable: Stack credential within program	(1)	(2)	(3)	(4)	(5)
Female	-0.0101**	-0.0072**	-0.0145***	-0.0049	-0.00702
Age	-0.0100***	-0.0108***	-0.0091***	-0.0021	-0.00472**
Age^2	0.0001***	0.0001***	0.0001***	0.0000	0.0001*
Latino	-0.0128***	-0.0133***	-0.0181***	-0.0127***	0.0021
Asian	0.0312***	0.0300***	0.0297***	0.0058	0.0128
African American	-0.0152**	-0.0107	-0.0148**	-0.0135**	-0.0157
Other/missing race	-0.0058	-0.0007	-0.0061	-0.0121	0.0116
Legal Permanent Resident	0.0095*	0.0136**	0.0093	0.0153***	0.0034
Other status	0.0513***	0.0498***	0.0510***	0.0495***	0.0452***
Less than high school	-0.0401***	-0.0432***	-0.0438***	-0.0350***	-0.0342**
AA	-0.0156	-0.0190*	-0.0148	-0.0155	-0.0306
BA+	-0.0192***	-0.0339***	-0.0198***	-0.0333***	-0.0332***
Other/missing education	-0.0430***	-0.0473***	-0.0354***	-0.0241***	-0.0013
Disability	0.0291***	0.0230***	0.0202***	0.0207***	0.0309***
Academic disadvantage	0.0266***	0.0257***	0.0277***	0.0203***	0.0176**

Dependent variable: Stack credential within program	(1)	(2)	(3)	(4)	(5)
Limited English	0.0382***	0.0484***	0.0452***	0.0415***	0.0567***
PELL	0.0665***	0.0666***	0.0638***	0.0521***	0.0431***
CalWORKs	0.0415***	0.0361***	0.0361***	0.0337***	0.0445***
Developmental math or English	0.1065***	0.1060***	0.103***	0.0990***	0.0956***
GPA	0.0279***	0.0319***	0.0280***	0.0263***	0.0424***
Work based courses		-0.0379***	-0.0526***	-0.171***	-0.189***
Evening courses		0.0336***	-0.0030	0.0323***	0.0008
Online courses		-0.1170***	-0.0685***	-0.202***	-0.241***
Average wage return for TOP code		-0.00346***	-0.0030***	-0.0020***	-0.0014***
IT	-0.0062434		0.0079	0.0319***	0.0517***
Engineering	0.0816474		0.0835***	0.0356***	0.0959***
Family and consumer	0.0649579		0.0670***	0.0510***	0.0723***
Public and protective	-0.0145007		-0.0020	-0.0043	0.0042
Constant	0.2412	0.327***	0.275***	0.139***	0.219***
Observations	66050	65,187	65,187	65,187	22,445
R-squared	0.055	0.055	0.061	0.098	0.108
Fixed effects					
Year				X	X
TOP 2	X		X	X	X
College				X	X
Exclusions					
Transfers included		X	X	X	
In scan only			X	X	X
Only 2010 forward					X

SOURCES: Authors calculations from COMIS data and pathway database.

NOTES: Reference categories are: white, high school graduate/GED, citizen. *** p<0.01, ** p<0.05, * p<0.1 The dependent variable is a bivariate on whether a student whose initial credential was a short-term certificate in one of our scanned colleges earned a related credential in the same program (ICN7) within 3 years.

To test whether program design is related to the odds a student stacks credentials, we estimate Model 5 including variables to indicate program features, as described in the text. Table B5 presents the estimates from those primary variables of interest. Each cell in the table is derived from a separate regression model. We do this to control which programs we are comparing in each case. For example, we test programs with strong progressive or launchpad/core pathways compared to programs with pathways that are just not explicit or to programs with no pathway, in turn. For this reason, the sample sizes vary greatly across models and are shown in Table B6.

Our main models examining pathway types include a host of demographic and program characteristics. However, to understand how the relationships vary across key dimensions, we re-estimate models separately by race/ethnicity, gender, and 2-digit TOP code. These models allow all of the factors related to stacking (not just program design but also age, educational background, college, etc.) to vary in their importance across groups. This specification is more flexible than a model that incorporates interactions, though in those we find qualitatively similar results.

TABLE B5

Main estimates from fixed effects models of program features on earning a stacked credential

Dependent variable: Stack credential within program	Overall	Latino	Asian	African American	White	Male	Female	Business	IT	Engineering	Family/ Consumer	Public/ Protective
Explicit pathways compared to…												
All others	0.0456***	0.0834***	0.0712***	-0.0468	0.0304*	0.0321**	0.0360**	0.0923***	0.0396	0.0832***	-0.0294	0.198***
Programs with no pathways	0.164***	0.173***	0.186***	0.167*	0.110***	0.150***	0.135***	0.0225	0.104	0.160***	0.492*	0.252***
Programs with light pathway features	0.0994***	0.113***	0.139***	0.00615	0.0713***	0.117***	0.0499**	-0.0669	0.105	0.135***	-0.00935	0.245***
Programs with pathway features (but not explicit)	0.0558***	0.0969***	0.0650**	-0.0458	0.0524***	0.0441***	0.0404**	0.113***	0.150	0.0351	-0.0202	0.114**
Other comparisons within pathway type												
Explicit launchpad/lattice programs vs programs with no strong pathway	0.0423***	0.0672***	0.108***	-0.0812	0.0422*	0.0466**	0.0174	-0.00959	0.0382	0.0877***	-0.0620	0.216***
Explicit progressive programs vs programs with no explicit pathway	0.0421***	0.0931***	0.0610*	-0.0126	0.00505	0.0322*	0.0415*	0.114***	0.106	0.114***	0.00973	0.132
Progressive programs vs programs with no pathway feature	0.0888***	0.145***	0.170***	0.136***	0.0177	0.0611***	0.162***	-0.0396	0.0592	0.251***	0.202***	-0.00406
Progressive programs vs programs with no feature (or certificate-AA only)	0.148***	0.192***	0.182***	0.199***	0.0949***	0.148***	0.204***	-0.0931	0.0767*	0.283***	0.235***	0.243***
Launchpad/Lattice programs vs programs with no pathway feature	0.144***	0.206***	0.211***	0.196***	0.0753***	0.124***	0.203***	-0.141**	0.0560	0.239***	0.179**	0.120***

SOURCES: Author calculations from COMIS data and pathway database.

NOTES: Each cell is the coefficient from a separate model. The dependent variable is a bivariate on whether a student whose initial credential was a short-term certificate in one of our scanned colleges earned a related credential in the same program (ICN7) within 3 years. All models include covariates listed in Table B4 Model 5, which includes student and program characteristics as well as year, college, and 2-digit TOP code fixed effects. Column headings refer to the subsample used in the regression model. Reference categories are: white, high school graduate/GED, citizen. *** p<0.01, ** p<0.05, * p<0.1. The sample size varies across each model, and are provided in the next table. Full results are available upon request. All models only include those students enrolled in programs in our catalog scan and enrolled from 2010 forward and who did not transfer within 3 years of their first career education credential, in addition restrictions on the comparison programs or subsamples noted in the table.

TABLE B6

Sample size for main fixed effects models of program features

	Overall	Latino	Asian	African American	White	Male	Female	Business	IT	Engineering	Family/ Consumer	Public/ Protective
Explicit pathways compared to…												
All others	22,429	8,520	3,026	1,774	8,173	11,566	10,863	4,262	1,237	5,332	6,713	4,885
Programs with no pathways	6,531	2,330	1,043	451	2,464	3,647	2,884	964	972	1,348	1,651	1,596
Programs with light pathway features	11,181	3,949	1,473	782	4,536	6,793	4,388	1,356	1,010	2,600	2,479	3,736
Programs with pathway features (but not explicit)	19,761	7,686	2,699	1,549	7,002	9,404	10,357	4,218	382	4,838	6,645	3,678
Other comparisons within pathway type												
Explicit launchpad/ lattice programs vs programs with no explicit pathway	20,557	7,915	2,509	1,708	7,557	10,697	9,860	3,623	1,191	4,827	6,147	4,769
Explicit progressive programs vs programs with no explicit pathway	20,687	7,684	2,893	1,631	7,598	11,059	9,628	4,126	1,174	5,052	5,697	4,638
Progressive programs vs programs with no pathway feature	13,171	5,388	1,710	1,101	4,416	5,016	8,155	3,154	230	1,861	5,183	2,743
Progressive programs vs programs with no feature (or certificate-AA only)	17,602	6,729	2,523	1,382	6,208	8,799	8,803	3,723	319	4,538	5,604	3,418
Launchpad/lattice programs vs programs with no pathway feature	22,044	8,409	2,983	1,756	7,970	11,500	10,544	3,903	1,237	5,344	6,688	4,872

SOURCES: Author calculations from COMIS data and pathway database.

NOTES: Each cell is the sample size of a separate model, corresponding with Table B5. Column headings refer to the subsample used in the regression model. Full results are available upon request. All models only include those students enrolled in programs in our catalog scan and enrolled from 2010 forward and who did not transfer within 3 years of their first CTE credential, in addition to the comparison programs in the first column and subsamples noted in the first row.

Table B7 reports the results from a number of additional tests of our main models. As above, each cell in this table is the main coefficient of interest from a separate regression model that also includes all covariates in Table B4 Model (5). The first three columns test the importance of pathway design on a variety of alternative student samples: (1) only students who re-enroll in a community college after their first short-term certificate (perhaps indicating an intent to complete a pathway), (2) adding students whose first award is a long-term certificate to the main sample, and (3) including students who transfer. Estimates on the relationship between pathway design and stacking are very similar across these student samples—they are also very similar to our main estimates above.

The last three columns of Table B7 test alternative dependent variables. We remove the restriction that a student must stack within 3 years, we require the student to stack on a slightly more narrowly defined pathway (ICN8), and we test stacking to higher-level credentials (from short-term to long- or associate). Once again, the results are quite similar.

TABLE B7

Additional tests on main models of program features on earning a stacked credential

	Dependent variable: Stack credential within program			Testing alternative dependent variables		
s	Students who re-enroll after first short-term certificate	Students whose first award is either a short- or long-term certificate	Students whose first award is a short-term certificate, regardless of transfer	Stack within ICN7 but no restriction on how long it takes	Stack within ICN8 within 3 years	Stack within ICN7 to a higher level credential
Strong pathway compared to…						
All others	0.0550***	0.0452***	0.0422***	0.0383***	0.0479***	0.0346***
Programs with no pathways	0.169***	0.164***	0.162***	0.167***	0.165***	0.0969***
Programs with light pathway features	0.0973***	0.113***	0.101***	0.0925***	0.108***	0.0663***
Programs with pathway features (but not explicit)	0.0797***	0.0527***	0.0489***	0.0468***	0.0589***	0.0230***
Other comparisons within pathway type:						
Explicit lattice programs vs programs with no explicit pathway	0.0732***	0.0427***	0.0489***	0.0387***	0.0411***	0.0163
Explicit progressive programs vs programs with no explicit pathway	0.0373**	0.0553***	0.0251**	0.0303**	0.0427***	0.0471***
Progressive programs vs programs with no pathway feature	0.0950***	0.117***	0.0918***	0.103***	0.0879***	0.0964***
Progressive programs vs programs with no feature (or certificate-AA only)	0.150***	0.175***	0.149***	0.163***	0.146***	0.115***
Lattice programs vs programs with no pathway feature	0.159***	0.162***	0.142***	0.159***	0.142***	0.114***

SOURCES: Author calculations from COMIS data and pathway database.

NOTES: Each cell is the coefficient from a separate model. The dependent variable is a bivariate that changes across models as indicated in column headings. All models include covariates listed in Table B4 Model 5 as well as year, college, and 2-digit TOP code fixed effects. Reference categories are: white, high school graduate/GED, citizen. *** p<0.01, ** p<0.05, * p<0.1. Only main effects are shown here, but full results are available upon request. Baseline models include those students enrolled in programs in our catalog scan and enrolled from 2010 forward and who did not transfer within 3 years of their first CTE credential, as well as sample restrictions noted in column headings.

PPIC

PUBLIC POLICY
INSTITUTE OF CALIFORNIA

The Public Policy Institute of California is dedicated to informing and improving public policy in California through independent, objective, nonpartisan research.

Public Policy Institute of California
500 Washington Street, Suite 600
San Francisco, CA 94111
T: 415.291.4400
F: 415.291.4401
PPIC.ORG

PPIC Sacramento Center
Senator Office Building
1121 L Street, Suite 801
Sacramento, CA 95814
T: 916.440.1120
F: 916.440.1121