FEATURE ARTICLES

Sometimes Less, Sometimes More: Trends in Career and Technical Education Participation for Students With Disabilities

Roddy Theobald[1], Jay Plasman[2], Michael Gottfried[3], Trevor Gratz[4], Kristian Holden[1], and Dan Goldhaber[1,4]

We leverage nationally representative data and statewide data from Washington to investigate trends in occupational career and technical education (CTE) participation for students with and without disabilities. Consistent with prior work, we document declines in occupational CTE participation since the early 2000s, but we provide the first evidence that this decline can be explained by movement out of courses that are no longer considered CTE. Under the definitions operating at the time, though, we show that participation by students with disabilities in applied science, technology, engineering, mathematics, and medical/health (STEMM) CTE courses has increased over time, both nationally and in Washington. These trends are encouraging given prior evidence linking applied STEMM-CTE participation to better long-term outcomes for students with disabilities.

Keywords: career development; longitudinal studies; secondary data analysis; special education; vocational education

A growing literature has connected participation in career and technical education (CTE) to better long-term outcomes for students with disabilities (e.g., Haber et al., 2016; Mazzotti et al., 2016; Test et al., 2009). For instance, students with disabilities who take more CTE courses in high school are more likely to graduate and be employed within 2 years of graduation compared with similar students with disabilities who take fewer CTE courses. These links persist even after controlling for baseline (i.e., demographic and academic) differences between students who do and do not participate in CTE (e.g., Dougherty et al., 2018; Lee et al., 2016; Theobald et al., 2019; Wagner et al., 2016).

The above finding buttresses the increased interest in promoting both CTE and science, technology, engineering, mathematics, and medical/health ("STEMM") coursework (e.g., American Federation of Teachers, 2014; National Academy of Sciences et al., 2007; National Research Council, 2000). Yet there is relatively little evidence about which students participate in which type of CTE courses. Older evidence suggests that enrollment in CTE by students with disabilities declined substantially across the 1990s and early 2000s (Wagner et al., 2004). And more recent evidence, focusing on all high school students, documented a 14% decline in CTE enrollment between 1990 and 2009, while the average number of earned academic credits increased during the same period (e.g., Hudson, 2013; Kreisman & Stange, 2020).

In the most recent decade, a different pattern appears, at least in some states. For example, Dougherty and Harbaugh Macdonald (2019) used data from Massachusetts to document variation in these trends for different CTE occupational areas across all students in the state and found that CTE participation is once again on the rise, particularly in CTE areas aligned with STEMM.

That said, the existing literature does not paint a complete picture of trends in CTE participation for students with and without disabilities over the past two decades. Specifically, neither the recent publications relying on nationally representative data (e.g., Kreisman & Stange, 2020) nor the recent publications that focus on a specific state (e.g., Dougherty & Harbaugh Macdonald,

[1]American Institutes for Research, Seattle, WA
[2]Ohio State University, Columbus, OH
[3]University of Pennsylvania, Philadelphia, PA
[4]University of Washington Seattle Campus, Seattle, WA

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2019) disaggregate trends for students with and without disabilities and by CTE course clusters. One exception is Gottfried et al. (2021), who use data from the High School Longitudinal Study of 2009 (HSLS:09) to disaggregate rates of CTE participation for students in one disability category (students with a learning disability) and in one CTE course cluster (STEMM-CTE). The central contribution of this article, therefore, is to build on this prior research using the most recently available nationally representative data *and* the most recently available data from a specific state (Washington State) to provide the first empirical evidence about how CTE participation for students with and without disabilities has changed both overall *and* by the full range of specific CTE course clusters. We first discuss the CTE policy backdrop that motivates this analysis, then highlight a particular CTE cluster of interest that has been linked to improved outcomes for students with disabilities—Applied STEMM CTE—and conclude this section by outlining our specific research questions.

CTE Policy Backdrop

The above trends have played out against the backdrop of several major national educational policies that may have influenced participation in CTE, particularly for students with disabilities. On the one hand, the No Child Left Behind Act of 2001 (NCLB) placed greater emphasis on academic performance and coursetaking, and potentially created greater incentives for enrolling in academic (i.e., non-CTE) courses for students with disabilities via the creation of a formal subgroup for these students for accountability purposes. The existing evidence documenting increasing academic coursework alongside decreasing CTE participation both generally (Kreisman & Stange, 2020) and for students with disabilities in particular (e.g., Wagner et al., 2004) in the early 2000s is consistent with the notion that accountability under NCLB for students' academic outcomes may have been important in increasing academic coursetaking and decreasing CTE participation during this time period.

On the other hand, as noted above, there is some evidence of a more recent rise in CTE participation. This finding is potentially explained by the expiration of NCLB in 2015, as well as by the reauthorizations of the Individuals with Disabilities Education Act (IDEA) in 2004 and the Carl D. Perkins Career and Technical Education Act in 2006 (Perkins IV). The 2004 IDEA reauthorization placed a greater emphasis on training and employment and contains provisions that require equal access to CTE courses for students with disabilities. And the Perkins IV Act in 2006 provided considerable increased funding for CTE and mandated that states develop "services and activities that integrate rigorous and challenging academic and career and technical instruction" (Carl D. Perkins Career and Technical Education Act, 2006). Notably, a key provision of Perkins IV was an increased emphasis on increasing the participation of "special populations," of which students with disabilities are one group, particularly in CTE coursework providing students with technical skills in STEMM areas (Plasman & Gottfried, 2018).

At the state level, numerous recent changes to graduation requirements intended to encourage CTE participation are also consistent with a recent uptick in CTE participation. For example, in 2013, Wisconsin allowed students to earn math and science credit through certain CTE courses such as those in the computer science cluster. In 2014, Arizona allowed computer science courses to meet math requirements for graduation. In the same year, Illinois approved AP Computer Science to substitute for required math courses. To be clear, we cannot say that the Perkins Act, the IDEA reauthorization, or changes in state graduation requirements can be causally linked to trends in CTE participation, but all of these legislative changes do encourage students to take more CTE courses and correspond to the uptick in CTE participation.

Given changes at both national and state levels, there are good reasons to focus on trends in CTE participation, especially over the past decade and with a particular focus on students with disabilities. Trends since 2010 are particularly important to understand given that sentiment around CTE is changing, due both to changes in state-level policy (Jacob, 2017) and significant media attention about 21st-century CTE as "not your father's vocational education" (e.g., Zinth, 2013). A more complete picture of CTE participation for students with disabilities and by CTE area also provides important policy evidence to inform CTE programming, given that this group of students that may differentially benefit from CTE, particularly in specific areas (e.g., applied STEMM).

STEMM CTE. Consistent with theory suggesting that the "applied" nature of CTE courses is better suited for engaging students with disabilities than courses with fewer direct applications (Brigham et al., 2011; Jenson et al., 2011), recent research has connected participation in applied STEMM CTE coursework to improved educational attainment for students with learning disabilities in particular (Plasman & Gottfried, 2018). Students with learning disabilities may also be more motivated to seek out CTE courses, because among students with disabilities, students with learning disabilities have the highest expectations regarding employment after high school (Wagner et al., 2007). Because of this prior research and the fact that students with learning disabilities make up the largest group of students served under IDEA (U.S. Department of Education, 2019), it is important to build on prior research in this area (Gottfried et al., 2021) and better understand trends in CTE participation for this group in particular.

We therefore build on limited prior research and investigate trends in CTE participation using data from three sources: nationally representative data from high school students from the Education Longitudinal Study of 2002 (ELS:02; Ingels et al., 2014) and the HSLS:09 (Ingels et al., 2015); and a state census of all high school students since 2010 from Washington State's Comprehensive Education Data and Research System (CEDARS, Washington State Office of the Superintendent of Public Instruction, 2018). Together, these data sets include the complete high school records of students with expected graduation dates in 2003–2004 and 2012–2013 from nationally representative data and for each graduating class between 2012–2013 and 2017–2018 from Washington data. Importantly, they allow us to investigate trends separately for students with disabilities and students without disabilities. We use these data sets to address two research questions:

Research Question 1: How has the average number of CTE credits taken during high school changed over time for students with learning disabilities compared with (a) students with other types of disabilities and (b) students with no identified disabilities?

Research Question 2: How do these trends vary within different CTE occupational areas?

Method

Data Sources

As mentioned above, this study used data from three sources: the ELS:02 and the HSLS:09, collected by the National Center for Education Statistics (NCES); and Washington state administrative data, provided by the Washington State Office of the Superintendent of Public Instruction. ELS:02 followed a nationally representative group of more than 16,000 students who were sophomores in the spring of 2002 through high school into postsecondary education and into careers. Students completed surveys during the base year in 2002, and high school transcripts were added in 2005. HSLS:09 tracked a nationally representative group of more than 23,000 students beginning during the fall of their freshman year in 2009. Students completed surveys at this time, and high school transcripts were added in 2014. Washington data came from the CEDARS data system that provided a census of student coursetaking records between 2009–2010 and 2017–2018 for the more than 80,000 students in each cohort in the state.

Sample

To ensure comparability of students across ELS:02, HSLS:09, and CEDARS data systems, we focused on students who entered ninth grade in a particular year and remained in the data for the next 3 years (i.e., until their expected year of graduation).[1] We refer to these cohorts on the basis of their expected graduation dates. For example, the 2003–2004 cohort consists of all students who entered ninth grade in 2000–2001 and remained in school for 2001–2002, 2002–2003, and 2003–2004 (note that this definition does not require students to remain on target for graduation or graduate on time, just that they were in school for those years). The years of available data allowed us to observe a nationally representative group of students for the 2003–2004 cohort from the ELS:02 data, a nationally representative 2012–2013 cohort from the HSLS:09 data, and a complete census of the 2012–2013 through 2017–2018 cohorts from the Washington data (subject to the restrictions above).

A key focus of this study was examining differences in coursetaking patterns for three groups of students: students with identified learning disabilities, students with other identified disabilities, and students without identified disabilities. In the ELS:02/HSLS:09 data sets, it was possible to identify disability status and category based on the base year survey Individualized Education Program information provided by a student's school and on a student's official school records. In the CEDARS data, we created these indicators from records of the disability code for which students were receiving special education services in ninth grade (to be consistent with the coding scheme in the ELS:02/HSLS:09 data sets).

CTE Participation Measures

We used two different coding methods to identify CTE courses and categories in this analysis. Both methods used codes from the Classification of Secondary School Courses (CSSC) for ELS:02 and the School Courses for the Exchange of Data (SCED) system for HSLS:09 and CEDARS. We used these codes to identify all "occupational CTE courses," which we define as those providing students with skills specific to a certain labor market field (as opposed to those that teach general employment skills).[2] We also used these codes to identify the CTE category of each course: agriculture and natural resources, applied STEMM (including medical courses as discussed below), business, communications, trades, public services, and human services.

We followed Dougherty and Harbaugh Macdonald (2019) and classified medical and health courses as applied STEMM.[3] This makes sense because many of these courses require prior knowledge in STEM and tend to be technical; for example, participation in nursing programs tends to require coursework in anatomy, physiology, and biology. Dougherty and Harbaugh Macdonald (2019) also noted that medical and health courses also tend to have stackable credentials and vertically integrated pathways, which are common in many STEM fields. The other CTE categories are based on previous work exploring CTE participation patterns (Plasman et al., 2017, 2019).[4]

A central concern in this analysis is ensuring that our coding of CTE courses and areas is consistent across the three different data sources. Fortunately, HSLS:09 and CEDARS share a course coding system (SCED), so we are able to use the exact same SCED codes within data set to match every course within each data set to specific CTE clusters. Washington is also one of 10 states for which HSLS:09 includes a state-representative sample. Moreover, the HSLS:09 sample of students were expected to graduate high school in 2012–2013, which overlaps with the graduation year for the first cohort of students in the Washington administrative data. All of this makes it possible to make direct comparisons between the Washington data and the HSLS:09 data, and to explore differences in CTE course coding between HSLS:09 and the Washington data. Specifically, we compared coding across the data sets using the state-representative subsample of roughly 1,000 Washington students in the HSLS:09 data to assess the degree to which the findings for this subsample line up with the census of Washington public school students in the CEDARS 2012–2013 cohort. This state-representative sample is not intended to be representative of student subgroups (e.g., students with disabilities), and sample sizes for students with disabilities in this sample are small, so we are only able to make this comparison across all students. We also extended the HSLS:09/Washington comparison by using the full, national sample from HSLS:09 to highlight where national and Washington participation levels diverged.

Given that ELS:02 uses a different course coding system (Classification of Secondary School Courses [CSSC]) and that longitudinal comparisons between the ELS:02 data and the later

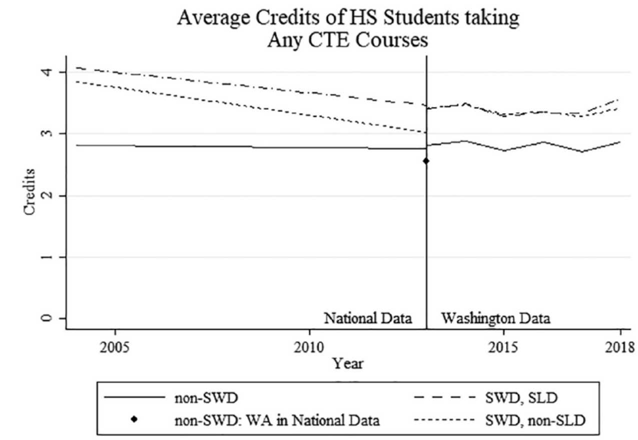

FIGURE 1. *Average CTE credits in high school by student subgroup, source coding.*
Note. Lines represent interpolations between data for observed cohorts. Estimates for each year are calculated across all 4 years of high school for students expected to graduate in that year and use the definitions of CTE courses in the source data sets. CTE = career and technical education; SWD = students with disabilities; SLD = specific learning disability.

data sets are central to this analysis, we use two different approaches to classifying courses in ELS:02. In the first approach (which we call "source coding"), we follow prior research (Plasman et al., 2017, 2019) and identify CTE courses and areas directly from the CSSC codes. The advantage of this approach is that it reflects the definitions and understanding of CTE *at the time when students and schools were making decisions about CTE courses*. In the second approach (which we call "NCES crosswalk"), we used a recently published crosswalk of CSSC and SCED codes (Henke et al., 2019) to map all CSSC codes in ELS:02 to SCED codes. We then classified CTE courses and areas directly from the SCED codes (i.e., using the same SCED codes as HSLS:09 and CEDARS). The advantage of this approach is that it ensures consistent coding across data sets, but at the cost of defining CTE courses and areas using definitions of CTE developed nearly a decade later than the data collected in ELS:02.

Our preferred approach is the "source coding" approach because this approach likely better represents how these courses were viewed at the time when schools were choosing to offer these courses and students were choosing to take them. As a specific example, we present in the Supplementary Appendix Table A2 (available on the journal website) the number of credits taken by students in different ELS course categories that are reclassified as STEMM or non-STEMM in ELS after using the NCES crosswalk (i.e., considered "non-STEMM" at the first time point and "STEMM" at the second time point under the source coding approach). The vast majority (>80%) of the changes to the Applied STEMM trends between source coding and crosswalk methods involved two course categories, "Business Data Processing and Related Programs" (including courses such as "Business Data Processing 1" and "Business Computer Programming 1") and "Industrial Arts" (including the course "Introduction to Technology"). There is good reason to believe that these courses have likely become more related to occupational STEMM over time (i.e., that it's appropriate to consider them as "Business" in the early 2000s but "Applied STEMM" in the early 2010s, as we do in the "Source Coding" method). In particular, and as discussed in a recent paper by Plasman et al. (2020), this is consistent with the emphasis in the most recent reauthorization of the Perkins Act that stressed a move away from CTE as a "skill-building platform" toward an "academic pursuit." But we present results using both approaches in the Results section, which is important given that this is the first article (to our knowledge) that has used the new NCES crosswalk.

Analytic Approach

Our primary measure of CTE participation was the average number of credits taken in occupational CTE courses over the 4 years of high school. To ensure consistency across different data sources, we converted all course credits to Carnegie Units (e.g., a student taking one CTE course for one semester would receive 0.5 Carnegie Units for this course) and refer to Carnegie Units as "credits" for the remainder of this analysis (Bradby et al., 2007). We calculated the average number of occupational CTE credits taken in high school (Research Question 1) and within different CTE areas (Research Question 2) for the 2003–2004 and 2012–2013 cohorts from the nationally representative data ("National Data"), and the 2012–2013 through 2017–2018 cohorts from the state census of students in Washington ("Washington Data"). Within each cohort, we report trends for three mutually exclusive groups of students: students with learning disabilities, students receiving special education services for different disabilities, and students without an identified disability.

Results

Research Question 1

Figure 1 addresses Research Question 1 and reports trends in the average number of occupational CTE credits taken during high school using the source coding (i.e., our preferred) approach for students without disabilities, students with learning disabilities, and students receiving special education services for different disabilities in each cohort and data set.[5] Under the source coding approach, the average number of occupational CTE credits declined by about 15% for both groups of students with disabilities between the 2004 and 2013 graduation classes but did not decline substantially for students without disabilities. In fact, we calculate that about half of the overall decline in CTE participation from this period that has been documented in prior research (e.g., Kreisman & Stange, 2020) can be explained by changes in the CTE participation of students with disabilities, despite the fact that students with disabilities represented just 13% of all public school students during these years.

That said, Figure 2 shows that this conclusion is not robust to the alternative coding system that uses the NCES crosswalk. Specifically, CTE participation under this coding system is found to increase during the 2000s for students without disabilities and students with a learning disability (and only declines marginally for students with a nonlearning disability). We interpret this as evidence that declines in CTE coursetaking over this period that have been documented in prior research (e.g., Kreisman &

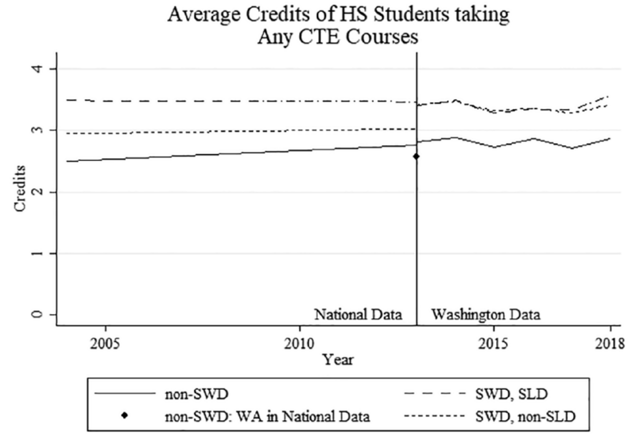

FIGURE 2. *Average CTE credits in high school by student subgroup, NCES crosswalk.*
Note. Lines represent interpolations between data for observed cohorts. Estimates for each year are calculated across all 4 years of high school for students expected to graduate in that year and use the definition of CTE courses from *Classification of Secondary School Courses* after applying the NCES crosswalk (Henke et al., 2019). CTE = career and technical education; NCES = National Center for Education Statistics; SWD = students with disabilities; SLD = specific learning disability.

Stange, 2020) are driven primarily by student participation in courses that *were* considered CTE in the ELS:02 data but are no longer classified as CTE under the newer SCED coding system. For example, courses such as Museology, Library Science, and Home Economics Leadership were coded as human services CTE courses in ELS, but are mapped to courses in HSLS using that NCES crosswalk that were not coded as CTE.

Our second finding (that is not influenced by the coding approach) is that the average number of occupational CTE credits is relatively consistent for all three groups of students in the 2012–2013 through 2017–2018 cohorts in Washington. Importantly, we do *not* observe a decline in overall occupational CTE participation for students with learning disabilities in Washington after 2013. The overall trends are broadly consistent with state-level evidence from Massachusetts (Dougherty & Harbaugh Macdonald, 2019) that actually documents a modest increase in CTE participation over a similar time period.[6]

Research Question 2

Figure 3 addresses Research Question 2 and investigates variation in these trends by occupational CTE area using the source coding approach. Indeed, we find that the trends in Figure 1 obscure important variation by occupational CTE area. Most notably, while the decline in occupational CTE participation for students with disabilities between the 2003–2004 and 2012–2013 cohorts is clearly driven by sharp decreases in the average number of credits taken in areas like agriculture and natural resources, business, human services, and trades—and the decline in trades participation is particularly stark for students receiving special education services for nonlearning disabilities—the average number of applied STEMM credits taken by students with disabilities actually increased during this same period. For example, between the 2003–2004 and 2012–2013 nationally representative cohorts, the average number of applied STEMM credits increased by about 40% for students with learning disabilities and by over 50% for other students receiving special education services (relative to only 30% for students without disabilities).[7]

Most of these findings are robust to the alternative coding approach that uses the NCES crosswalk, but the notable exception is that Applied STEMM coursetaking only increases between 2004 and 2013 for students with nonlearning disabilities under this coding system. Given the differences between the source coding and NCES crosswalk coding systems, this is the result of courses that were classified as Applied STEMM in the CSSC system no longer being classified as Applied STEMM in the SCED system. As one check on this, we present additional results in Figure 5 that only include courses that did not change classifications between the two systems, and again see a decline in Applied STEMM coursetaking over this period. We therefore further explored the raw data and concluded that the changing results for Applied STEMM appear to be driven by classes in "Business Computing/Technology" and "Computers/Computer Applications/Repair" being labeled as Applied STEM classes in ELS, but not being matched to SCED course codes (via the NCES crosswalk) that are considered as Applied STEM in HSLS. Thus, the conclusions about Applied STEMM appear to be depend on the extent to which courses like "Business Computing" should be considered as Applied STEMM. As discussed in the Methods section, our preferred approach is the "source coding" method (i.e., suggesting increases in Applied STEMM participation) as we believe it better represents how this type of course was viewed *at the time that the data were collected*.

Turning to conclusions from the Washington data from Figures 3 to 5 (that, again, are not sensitive to coding approach), the increase in applied STEMM participation continues through 2017–2018 when we focus on the Washington data over the past 5 years. Specifically, the average number of applied STEMM credits increased by about 15% to 25% for students in each subgroup in Washington between the 2012–2013 and 2017–2018 cohorts.[8]

Discussion

We document trends in CTE participation for students with and without disabilities using nationally representative data and a census of public school students in Washington State. Importantly, we find that both overall trends and participation within specific CTE areas like Applied STEMM are sensitive to the coding method we use. This is an important finding in itself, as it suggests that observed trends documented in prior research (e.g., Hudson, 2013) are driven in part by changing definitions of CTE over time.

Our study reflects an example of this. Under our preferred coding approach that uses the source definitions of CTE and complements prior research (e.g., Hudson, 2013; Plasman et al., 2017, 2019), we find that students (and particularly students with disabilities) in the past decade are taking fewer occupational CTE courses, on average, than they were in the early

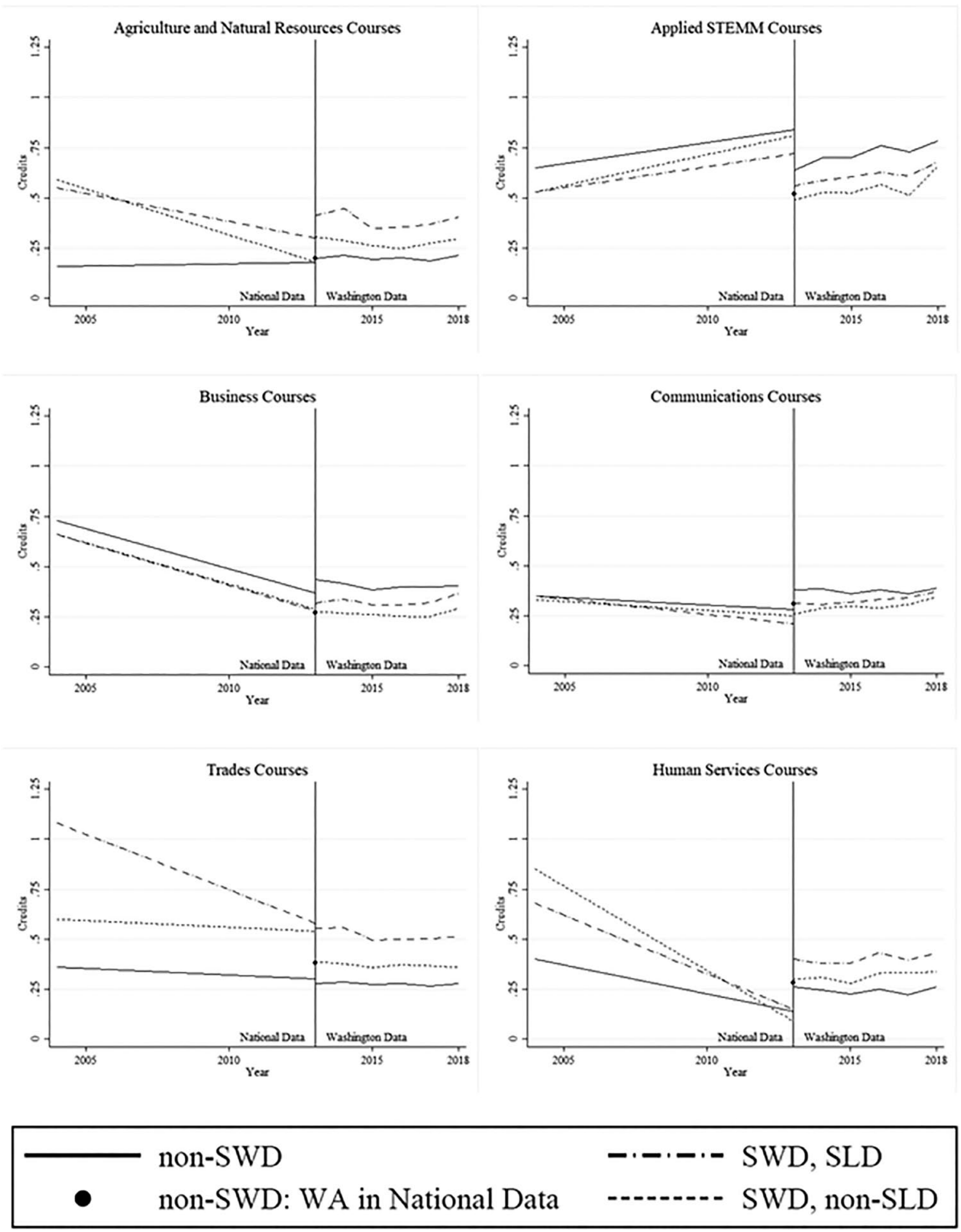

FIGURE 3. *Average CTE credits in high school by student subgroup, source coding.*

Note. Lines represent interpolations between data for observed cohorts. Estimates for each year are calculated across all 4 years of high school for students expected to graduate in that year and use the cluster definitions in the source data sets. STEMM = science, technology, engineering, mathematics, and medical/health; CTE = career and technical education; SWD = students with disabilities; SLD = specific learning disability.

2000s. As discussed above, that trend is consistent with the hypothesis that federal policies from the early 2000s placed an increased emphasis on academic coursework over occupational CTE coursework. Recent evidence has linked concentrated CTE participation to improved graduation and employment for students with disabilities (Dougherty et al., 2018; Lee et al., 2016; Theobald et al., 2019; Wagner et al., 2016), so while this earlier research is not causal in nature, the declining participation in CTE by students with disabilities documented in this study could be interpreted negatively for policymakers and

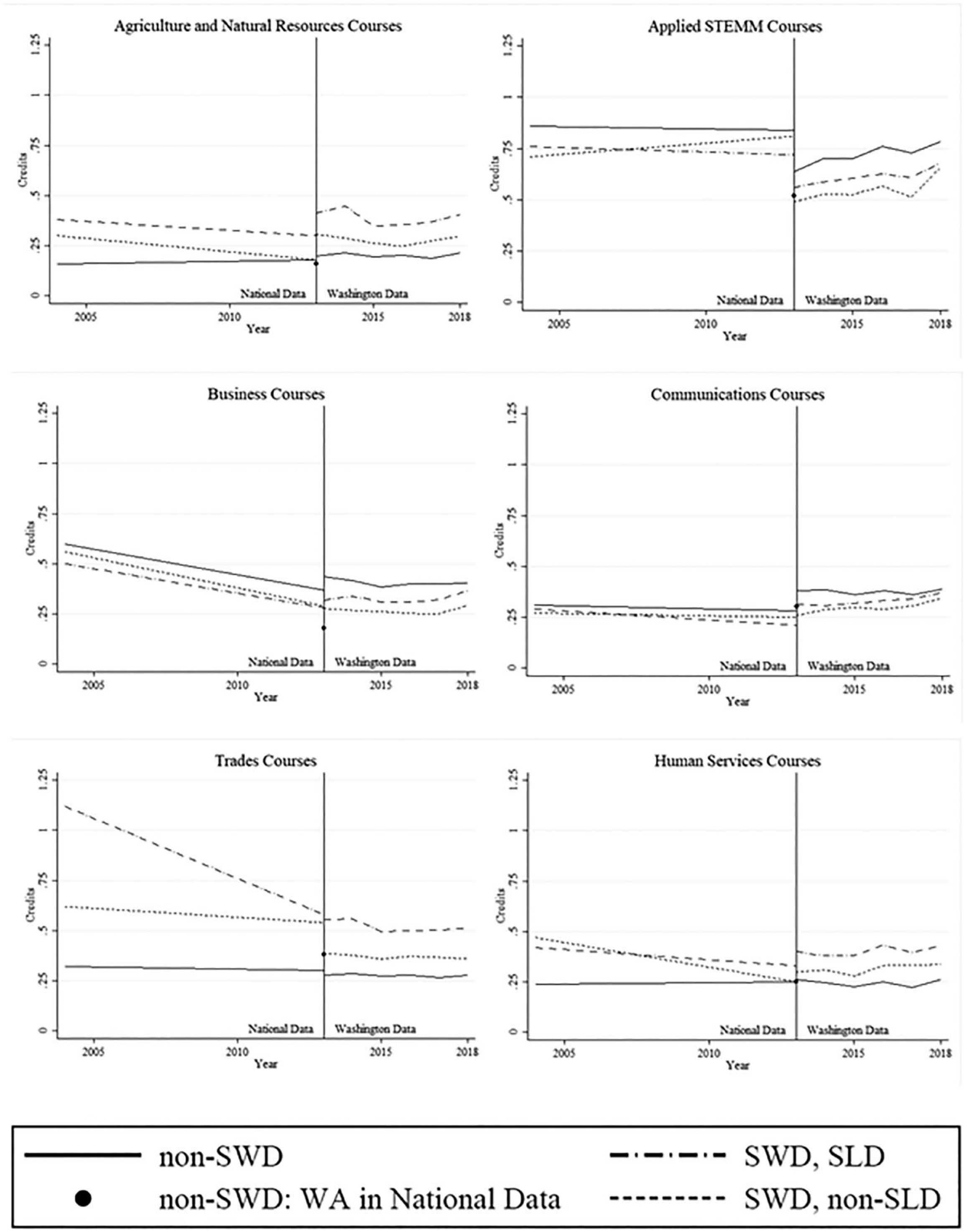

FIGURE 4. *Average CTE credits in high school by student subgroup, NCES crosswalk.*
Lines represent interpolations between data for observed cohorts. Estimates for each year are calculated across all 4 years of high school for students expected to graduate in that year and use the cluster definitions from the *Classification of Secondary School Courses (CSSC)* after applying the NCES crosswalk (Henke et al., 2019).
Note. STEMM = science, technology, engineering, mathematics, and medical/health; CTE = career and technical education; NCES = National Center for Education Statistics; SWD = students with disabilities; SLD = specific learning disability.

educators who want to improve outcomes for students with disabilities (e.g., Lipscomb et al., 2017). On the other hand, our alternative coding approach suggests that the decline in CTE participation is driven by movement out of courses that are no longer considered CTE and are not included in the definition of CTE in these more recent studies, so further research is necessary to disentangle the impacts of the these two trends on student outcomes.

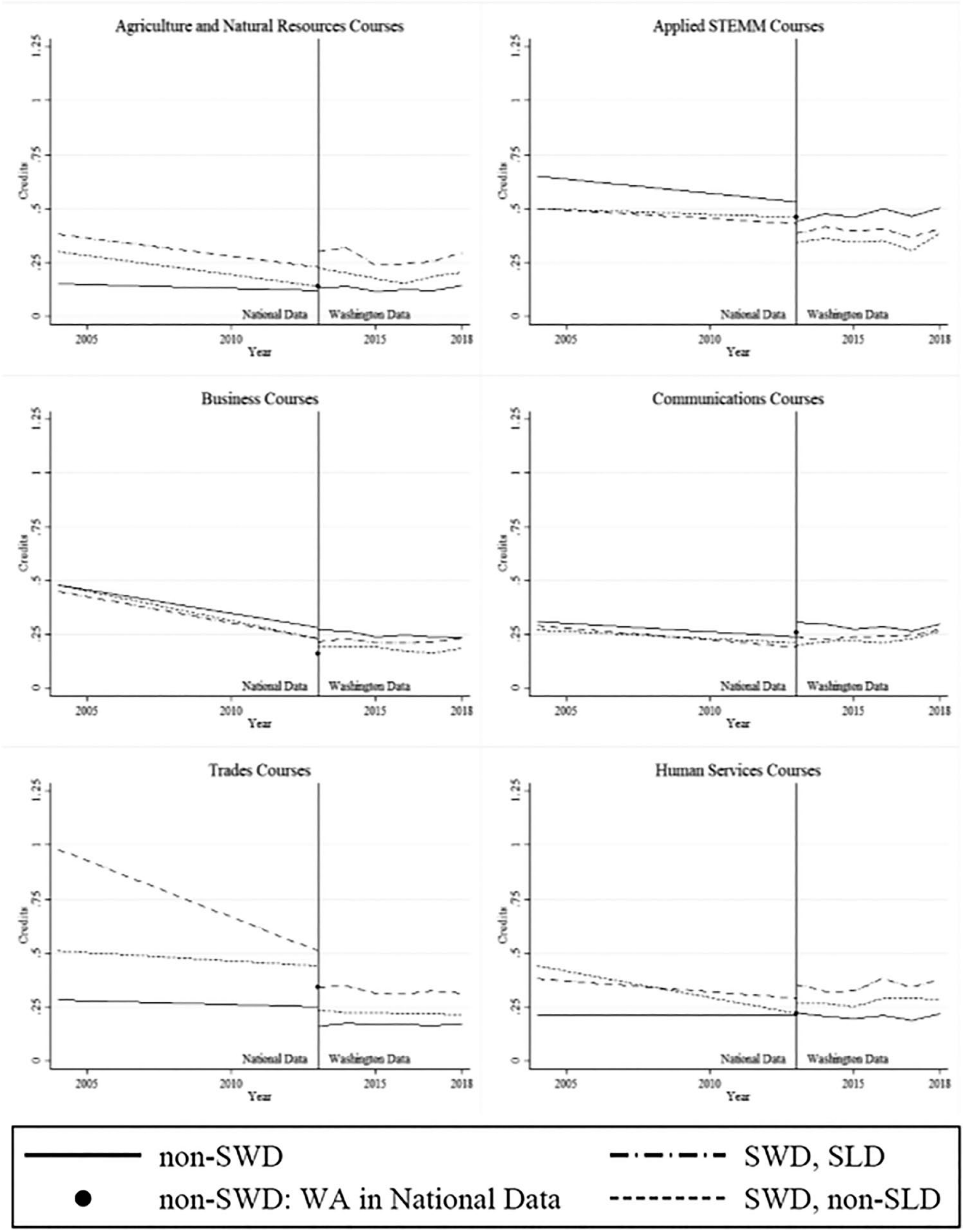

FIGURE 5. *Average CTE credits in high school by student subgroup, consistent clusters.*
Note. Lines represent interpolations between data for observed cohorts. Estimates for each year are calculated across all 4 years of high school for students expected to graduate in that year and use the cluster definitions from the *Classification of Secondary School Courses*, applying the National Center for Education Statistics crosswalk (Henke et al., 2019) and limiting to courses for which the cluster does not change after applying this crosswalk. STEMM = science, technology, engineering, mathematics, and medical/health; CTE = career and technical education; SWD = Students with disabilities; SLD = specific learning disability.

We also find differences in occupational CTE participation patterns across different areas. Most notably, using our preferred coding approach, participation in applied STEMM increased across the entire period we consider, which may reflect a larger trend that deemphasizes traditional vocational education in favor of more technical areas such as science and math (Benavot, 1983; Young, 2008). The increases in applied STEMM participation are also consistent with mandates in Perkins IV to expand technology use in

CTE and prepare students for high-demand occupations (Dougherty & Harbaugh Macdonald, 2019), so these trends could also reflect changes in federal CTE policy that shifted resources toward these occupational CTE areas. Since previous research (Plasman & Gottfried, 2018) has linked applied STEMM participation to improved outcomes specifically for students with learning disabilities, including odds of graduation and odds of postsecondary enrollment, we interpret these trends as encouraging. We again caution, however, that the increases in applied STEMM participation are not robust to the coding system we use, so further research is necessary to connect changes in student participation in *specific applied STEMM courses* to subsequent outcomes for students with disabilities.

The trends documented in this study are also consistent with a separate goal of the Perkins IV legislation to increase participation in applied STEM areas of study (those CTE clusters that focus on technical skills in math and science) in an effort to improve college and career readiness. But it is worth noting that, as shown in Figures 3 to 5, this push may be coming at the expense of other CTE clusters. If students are substituting away from clusters that are in lower demand, consistent with the Perkins IV requirement to focus on high-demand industries, then this is a positive shift. But while STEMM careers (particularly in the health field) do make up a large percentage of predicted job openings over the next decade, it is also important to consider the needs of the skilled trades labor market as well as the business sector. Both these areas are also expected to see substantial growth, as well as gaps in labor availability, in the next decade. These fields should not be forgotten and pushed aside when considering CTE in general.

Finally, states play a very clear role in boosting participation in CTE through special education policy, and this is an active area of policy activity, as 13 states made changes to their graduation requirements regarding CTE courses in 2013, while 18 states made changes in 2018 (Association for Career and Technical Education, 2013, 2018). In some states (like Washington), the CTE participation requirement is for any CTE cluster, while in many states the emphasis is on STEMM courses. Moreover, following the passage of the federal Perkins V Act in 2018 that mandated improved alignment between high school CTE programs of study and postsecondary credentials, some states are creating specific CTE pathways to graduation. For example, the Washington State legislature recently passed House Bill 1599 that provided Washington high school students with multiple pathway to graduation, including new CTE Graduation Pathways in 16 state-approved "career clusters." Further efforts may look to align policies across various stakeholder levels in order to encourage participation and persistence in the CTE clusters most vital in a given region, and to work more diligently to increase participation for students with disabilities. Thus, we encourage future research that seeks to disentangle the competing implications of these trends for students with disabilities.

ORCID IDS

Jay Plasman https://orcid.org/0000-0003-1071-8270
Trevor Gratz https://orcid.org/0000-0003-4260-4040
Dan Goldhaber https://orcid.org/0000-0003-4260-4040

NOTES

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[1]In extensions discussed in the Results section, we relax this assumption for students in the CEDARS data (that include transcript data for all students, not just students who are observed in the initial ninth-grade cohort).

[2]Occupational courses are those that teach skills required in specific occupations or occupational clusters. Examples of such courses would include the following: electromechanical systems, finance, or AP computer science. Nonoccupational courses, on the other hand, encompass courses that fall into the family and consumer sciences category or general labor market preparation (i.e., those that teach general employment skills). Examples of family and consumer sciences courses would include child development/parenting and food science, whereas general labor market preparation courses might include word processing and career exploration.

[3]In extensions discussed in the Results section, we also discuss results that do not include these courses in the definition of Applied STEM.

[4]In Panel A of Table A1 in the supplementary materials (available on the journal website), we illustrate how the 21 occupational CTE clusters from Bradby and Hudson (2007) map onto our 7 CTE clusters. Similarly, we use the subject area from Bradby et al. (2007) report on SCED course codes to classify 11 subject areas into 7 CTE cluster areas. This classification is depicted in Panel B of Table A1 in the supplementary materials (available on the journal website).

[5]In the supplementary materials (available on the journal website), we present an alternative figure to Figure 1 that includes confidence intervals for students with learning disabilities (Figure A1), students with a different disability (Figure A2), and students without disabilities (Figure A3). The observed values from the CEDARS data often fall outside the 95% confidence interval for the comparable estimate from the HSLS data, so for the remainder of this section, we only interpret trends across the national and Washington data sets and avoid comparing the overall levels of participation.

[6]There is some evidence that these results could be driven in part by inclusion of students with disabilities in general education classrooms, as inclusion levels were increasing over the years of data we consider; see Gilmour (2018) for national data and Figure A4 in the supplementary materials (available on the journal website) for Washington data.

[7]Figure A5 in the supplementary materials (available on the journal website) shows that these results are less pronounced when we do not include medical courses in the definition of Applied STEM.

[8]We also use the Washington data to explore the sensitivity of the results in this section to the on-time graduation restriction in Figures A6 and A7 in the supplementary materials (available on the journal website; note that the HSLS:09 and ELS:02 data do not provide the necessary variables to make a similar restriction, which is why we make this restriction to the CEDARS data to ensure comparability with these earlier data sets). As expected, these figures show lower overall levels of CTE participation, but maintain the same trends and subgroup relationships as those presented in the main findings.

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AUTHORS

RODDY THEOBALD, PhD, is a principal researcher in CALDER at American Institutes for Research, 3876 Bridge Way North, Suite 201, Seattle, WA 98103; *rtheobald@air.org*. His research focuses on teacher education, teacher licensure, special education, and career and technical education.

JAY PLASMAN, PhD, is an assistant professor at The Ohio State University, 172 Arps Hall, 1945 High Street, Columbus, OH 43210; *plasman.2@osu.edu*. His research focuses on education policy as it relates to college and career readiness and benefits from participation in career and technical education as well as the potential of career and technical education to help improve outcomes for traditionally underrepresented groups.

MICHAEL GOTTFRIED, PhD, is an associate professor in the Graduate School of Education at the University of Pennsylvania, 3700 Walnut Street, Philadelphia, PA 19104; *mgottfr2@upenn.edu*. His research focuses on the economics of education and education policy, including career and technical education and students with disabilities.

TREVOR GRATZ, BS, is a research consultant at the Center for Education Data and Research (CEDR) at the University of Washington, 3876 Bridge Way North, Suite 201, Seattle, WA 98103; *gratzt@uw.edu*. His research focuses on the intersection of health, health care, and students' educational outcomes.

KRISTIAN HOLDEN, PhD, is a researcher in CALDER at American Institutes for Research, 3876 Bridge Way North, Suite 201, Seattle, WA 98103; *kholden@air.org*. His research focuses on students with disabilities and career and technical education.

DAN GOLDHABER, PhD, is the director of CALDER at American Institutes for Research, and also the director of CEDR at the University of Washington, 3876 Bridge Way North, Suite 201, Seattle, WA 98103; *dgoldhaber@air.org*. His research focuses on issues of educational productivity and reform at the K–12 level, the broad array of human capital policies that influence the composition, distribution, and quality of teachers in the workforce, and connections between students' K–12 experiences and postsecondary outcomes.

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