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Career and Technical Education, Inclusion, and Postsecondary Outcomes for Students With Learning Disabilities

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Abstract

We used longitudinal data from Washington State to investigate the relationships among career and technical education (CTE) enrollment, inclusion in general education, and high school and postsecondary outcomes for students with learning disabilities. We replicated earlier findings that students with learning disabilities who were enrolled in a "concentration" of CTE courses had higher rates of employment after graduation than observably similar students with learning disabilities who were enrolled in fewer CTE courses. We also found that students with learning disabilities who spent more time in general education classrooms in high school had higher rates of on-time graduation, college attendance, and employment than observably similar students with learning disabilities who spent less time in general education classrooms in these grades.

Keywords

inclusion, quantitative research methods, transition

There is a burgeoning literature that used statewide administrative data sets to investigate the factors influencing postsecondary outcomes for public school students in general. However, students with learning disabilities have received far less empirical attention in this literature, despite the fact that it has been more than a decade since the 2004 reauthorization of the Individuals with Disabilities Education Act, which placed greater emphasis on improving the postsecondary outcomes for all students with disabilities. This is particularly surprising given that the U.S. Department of Education's Office of Special Education Programs has identified postschool outcomes for students with disabilities as a monitoring priority.

Moreover, there is mounting descriptive evidence demonstrating that students with disabilities continue to lag behind their peers in terms of college attendance and employment success. These studies documented deficits across all disability categories, and many focused on students with learning disabilities. Many of these studies also pointed to better employment outcomes for students with learning disabilities relative to other students with disabilities (e.g., Affleck, Edgar, Levine, & Kortering, 1990; Newman, Wagner, Cameto, Knokey, & Shaver, 2010; Wagner 1992) as well as higher achievement scores (Wagner, Newman, Cameto, Levine, & Garza, 2006). In contrast, Wagner (1992, 1993) noted that these students have lower grade point averages and among the highest dropout rates across disability categories. This is important because Karpinski, Neubert, and Graham (1992) found large disparities in employment outcomes between students with learning disabilities who graduated and those who dropped out.

Several small-scale case studies have provided correlational evidence that enrollment in a concentration of career and technical education (CTE) courses—which we define as at least four credits of coursework that provides academic and technical skills for future careers and independent living—and inclusion in general education classrooms could improve high school and postsecondary outcomes for students with disabilities. For example, Hasazi, Gordon, and Roe (1985) and Baer et al. (2003) found that CTE enrollment predicted employment success for former special education students, and Baer et al. and Mithaug, Horiuchi, and Fanning (1985) similarly found correlations between inclusion and postsecondary education and employment success. Rea, McLaughlin, and Walther-Thomas (2002) also found that inclusion was associated with better test scores, behavior, and attendance in high school. However, the small sample sizes in these studies

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(often <100 students) may raise questions about the generalizability and robustness of these findings.

Only a handful of larger-scale studies connected CTE enrollment and inclusion to postsecondary outcomes; most of these focused on estimating the effects of CTE enrollment. Benz, Lindstrom, and Yovanoff (2000) and Harvey (2002) found that CTE enrollment was predictive of employment success, postsecondary education, or both for all students with disabilities, and Sitlington and Frank (1990) found benefits specifically for students with learning disabilities. These findings were reinforced in a review by Test et al. (2009), who found that—among 16 evidence-based in-school predictors of the postsecondary success of students with disabilities—CTE enrollment was consistently predictive of postsecondary outcomes. Haber et al. (2016) conducted a meta-analysis that provided further evidence on the predictors identified by Test et al. and found that CTE enrollment had no correlation with education outcomes but was positively predictive of employment and that inclusion was a larger predictor than that typically found in the literature. Finally, Mazzotti et al. (2016) provided a systematic review that extended past 2009, a period that included the release of the National Longitudinal Transition Study–2 data widely used to study the postsecondary outcomes of students with disabilities. They found additional support for 9 of the factors studied by Test et al., with inclusion and CTE enrollment continuing to be predictive of education and employment outcomes.

That said, a significant shortcoming of much of this prior work (including many of the studies considered in the meta-analyses earlier) is that they did not control for baseline measures of student achievement or other nonschooling factors (e.g., participation in free or reduced-price lunch programs) that may confound the relationship among CTE enrollment, inclusion, and postsecondary success. In this study, we defined baseline measures of student achievement (or student competence) as a student's innate ability to perform academic tasks, as measured via performance on standardized tests, prior to one's enrollment in high school. These measures were important because they likely influence participation in CTE enrollment and inclusion as well as postsecondary success and could confound estimates of the relationships among CTE enrollment, inclusion, and postsecondary outcomes.

A few notable prior works attempted to control for baseline measures of student achievement in estimating these relationships. Wagner (1991) considered CTE enrollment and inclusion as predictors of the high school and postsecondary success of students with disabilities, using data from the National Longitudinal Study of Special Education Students to estimate models that included controls for baseline performance measures (functional mental skills and IQ score) and household characteristics (single parent and household income). The estimates from these models suggested that CTE enrollment and inclusion are correlated with secondary school performance, graduation, education, employment, and personal independence, conditional on the observed characteristics of students. In contrast, Heal and Rusch (1995) used the same data set to investigate employment outcomes for students with disabilities but found that school programs for these students (including CTE enrollment) "had minimal effect on postschool employment once student competence and family characteristics had been controlled for." These disparate findings may be due to methodological differences—Wagner included all student controls in all models, whereas Heal and Rusch used forward selection to select their control variables—but more important, the evidence from these studies is now approximately 20 years old.

This study builds most directly on recent work by Wagner, Newman, and Javitz (2016), who reconsidered CTE enrollment as a predictor of postsecondary outcomes for students with learning disabilities and used a longer panel of data and propensity score matching on baseline performance and family characteristics. They found that students with learning disabilities who participated in a "concentration" of CTE courses were more likely to be employed within 2 years of leaving high school but not in later years. Wagner et al. also noted that CTE participation among students with learning disabilities declined in recent years while academic course taking increased, which is an important argument for more recent studies that evaluated CTE enrollment for students with learning disabilities.

This study intends to build on this prior research base by using detailed administrative data on public school students in Washington State, linked to postsecondary education and employment data, to examine the relationships among CTE enrollment, inclusion in general education, and high school and postsecondary outcomes for students with learning disabilities. This is the first statewide study to consider the relationship between CTE enrollment and postsecondary outcomes for students with learning disabilities, thus providing an important contribution to the existing literature that relies on either small case studies or nationally representative survey data (e.g., Wagner et al., 2016). This is also the first large-scale study since that of Wagner (1991) to evaluate the relationship between inclusion in general education classes and postsecondary outcomes for students with learning disabilities while controlling for robust measures of student baseline performance that may confound these relationships.

Specifically, this study investigated two broad descriptive research questions:

1. *Research Question 1*: Are CTE enrollment and inclusion predictive of high school outcomes (unexcused absences and on-time graduation) for students with learning disabilities?

2. *Research Question 2*: Are CTE enrollment and inclusion predictive of the postsecondary success (college enrollment and employment) of students with learning disabilities?

Method

Sample and Participants

The sample for this analysis included 5,122 students who were receiving special education services for a specific learning disability (SLD) in Washington State public schools in 10th grade in 2009–2010 or 2010–2011. Because we had detailed special education data starting in 2009–2010 linked to postsecondary data through 2013–2014, we were able to follow these cohorts of students with learning disabilities from 10th grade through 1 year beyond their expected high school graduation year. Within each cohort, we defined the sample in subsequent grades as students with learning disabilities who were still "on track" to graduate on time (i.e., 11th graders in each cohort consist only of students from the 10th-grade sample who proceeded to 11th grade the following year). We also calculated summary statistics for students without disabilities as well as students with disabilities other than SLD in these cohorts to investigate differences in student outcomes for our population of interest.

Data Sources

The data for this project were maintained by Washington State's Education Research and Data Center, a P–20 student data warehouse that combined administrative K–12 data with college and employment data. The K–12 data came from Washington State's Comprehensive Education Data and Research System (CEDARS), a longitudinal data system introduced in the 2009–2010 school year. We used two primary files for this analysis: a student enrollment and program file that included detailed data about special education services and a student schedule file that included one entry for each student and course in which the student was enrolled. Although the CEDARS data system was introduced in the 2009–2010 school year, it could be linked to some of the data sets that preceded it, such as test scores and previous school enrollment records, which allowed for baseline controls for student test achievement. The CEDARS enrollment data also contained 15 codes for student disability type, which we used to restrict the primary sample to SLD students.

We supplemented this data set with the P-210, an annual federal enrollment compliance report constructed by the state's Office of Superintendent of Public Instruction from the CEDARS data. The P-210 contained the final record of enrollment status (e.g., graduate or dropout) for each student in each year. Using the P-210 for available school years (2008–2009 through 2011–2012) and the CEDARS enrollment data for the later school years (2012–2013 and 2013–2014), we constructed a student year–level data set with grade and enrollment status at the end of the year. We then included student control variables, including eighth-grade test scores (math, reading, and science), race/ethnicity, housing and migrant status, gender, free or reduced-priced lunch eligibility, and program participation in English language learning, part-time home schooling, and gifted/highly capable programs.

In the introduction, we identified two measures of postsecondary success for students with learning disabilities: enrollment in a Washington State public college and employment in the Washington State workforce. We can investigate college outcomes because of unique student identifiers in the data sets provided by the Education Research and Data Center that connected students in the CEDARS K–12 data system with data from the state's colleges: the Public Centralized Higher Education Enrollment System for public 4-year universities in Washington State and the State Board of Community and Technical Colleges data system for public 2-year colleges in Washington State. An important caveat is that these data sets did not cover out-of-state colleges or in-state private colleges. We could also link the CEDARS K–12 data system to the unemployment insurance (UI) records of all individuals employed in positions that pay UI in Washington State. The UI records were reported on a quarterly basis and run from 2010 through 2013 on the calendar year.

Measures

The first key measure in this study was enrollment in CTE courses, which the CEDARS student schedule file classified via Classification of Instructional Program codes. CTE courses in Washington State cover a range of topics, and the five most common CTE course areas for students with learning disabilities in our sample were as follows: agriculture, food, and natural resources; arts, A/V technology, and communications; health sciences; information technology; and human services. These areas included classes titled Digital Communication Tools, Family Health, Nutrition and Wellness, Office Specialist, and Commercial Photography.

We first created indicators for whether each student with learning disabilities was enrolled in a CTE course in 10th, 11th, and 12th grades. We then followed Wagner et al. (2016) and considered whether students with learning disabilities were enrolled in a "concentration" of CTE courses in high school. Like Wagner et al., we defined concentration as having taken four or more credits of CTE courses in high school. Rates of concentration were quite similar between studies, with 35.6% of students with learning disabilities in our sample having taken a concentration of CTE courses during high school and 36.8% in the Wagner et al. study.

The second key measure was the extent of each student's inclusion in general education classrooms, which we coded from the "least restrictive environment" code in the CEDARS student enrollment and programs file that indicated the percentage of the school day (80%–100%, 40%–79%, <40%) that each student spent in general education classrooms. Note that students with learning disabilities who spent more time in general education classrooms had considerably higher baseline levels of achievement than did students with learning disabilities who spent less time in general education. However, because we were able to control for these differences in baseline performance directly in the analytic models described in the next section, these differences should not bias our results. Finally, we do not consider the interaction between inclusion and CTE enrollment, because the CEDARS data do not provide information about the extent of inclusion in specific courses.

We considered two types of outcomes for this study: high school outcomes (Research Question 1) and postsecondary outcomes (Research Question 2). High school outcomes included unexcused absences and on-time graduation, which were available in the CEDARS K–12 database. Postsecondary outcomes include college enrollment and employment. Using the Public Centralized Higher Education Enrollment System and State Board of Community and Technical Colleges data systems, we created a variable for each student that indicates whether the student enrolled in a public in-state college within 6 months after her or his expected graduation. From the UI records, we constructed indicators for being employed more than half time for each of the two quarters after a student's expected graduation. We then took the maximum of these two indicators to determine whether an individual was employed more than half time in any quarter within the first 6 months of one's expected graduation.

Analytic Approach

Our analytic approach was to estimate a series of student-level models predicting our measures of high school and postsecondary student success. As described in the introduction, these models controlled for a variety of student characteristics, including baseline measures of performance not utilized in many prior studies. However, we view these models as descriptive because our controls may not have sufficiently addressed potential sources of bias.

Specifically, three sources of selection bias could be problematic for the models described in this section. First, students with learning disabilities could have participated in more CTE courses or have been placed in more general education classes because of unobserved factors that also correlated with their outcomes. For example, high-ability students with learning disabilities likely had better postsecondary outcomes regardless of CTE enrollment; if they were more motivated to enroll in CTE courses, then the association between enrollment in CTE courses and postsecondary outcomes would reflect selection bias instead of a causal relationship. Our primary solution to this potential source of bias was to include a rich set of control variables in all models, including baseline measures of performance and other observable student and peer characteristics. This strategy ensured that students with learning disabilities were being compared with other students who had learning disabilities with similar prior achievement and observable characteristics and who were taking classes with similar types of students.

A second source of selection bias may have occurred if districts chose to offer more CTE classes or placed fewer students with learning disabilities into general education classrooms because of the population of students they served (e.g., because students with learning disabilities in the district were "struggling"). We addressed this potential source of bias by including district fixed effects in our primary model specifications to compare students within the same district, as well as by controlling for baseline academic performance and other observable student and peer characteristics.

A third source of selection bias may occur if parents choose to send their children to a specific school or district because of the special education services that they offer (e.g., more CTE classes targeted to students with learning disabilities). The role of parents in selecting the schools and districts that their children attended could be particularly problematic for students with learning disabilities. Parents may pay close attention to the special education services offered by different schools and districts before selecting the best schooling environment for their children. If motivated parents are more likely to place their children in schools and districts with more extensive special education services, then parental involvement will confound the estimates from the models described here. Unfortunately, we do not believe that there is any way (short of an experiment) to mitigate this source of bias, which is one reason why we ultimately view this as a descriptive study.

In addition to the sources of bias described earlier, we need to consider several data challenges in developing our analytic models. The first challenge is the considerable attrition from the analytic samples from 10th to 12th grade. This attrition appears not to be random (e.g., lower-performing students are more likely to leave the sample) and could be due to students dropping out of school, moving to a private school, or moving to a school outside the state. In many cases, we can distinguish among these competing explanations—for example, if a student drops out of school in the middle of the school year, then this data set includes one of the dropout codes discussed earlier—but the exit reason cannot be determined for many students who leave between school years. Another challenge is that many of the key variables that we consider (as well as many of the control variables described earlier) were time varying. For example, a student may have enrolled in a CTE course in 10th grade but not in 11th or 12th grade, or a student may have attended general education classes for >80% of the school day in 12th grade but only 40% to 79% of the school day in previous grades.

Our solution to each challenge was to define and estimate models separately by grade and to estimate these models only for the subset of students who were still attending Washington State public schools in that grade. This separation means that our estimates in each grade can be interpreted only for the subset of students who remain in Washington State public schools in that grade. Although this approach may seem restrictive, it does make intuitive sense because CTE enrollment and inclusion in 12th grade can affect only students who were still enrolled in school in 12th grade.

We first considered predictors of student unexcused absences, one of the high school outcomes described earlier. For each student in our analytic sample in grade g, we observed the number of unexcused absences, ABS_g. We modeled this outcome as a function of student control variables in grade g, $\mathbf{X}_g$, and the key measures (CTE concentration and inclusion in grade g), $\mathbf{M}_g$.

$$ABS_g = \alpha_0{}^g + \alpha_1{}^{gT}\mathbf{X}_g + \alpha_2{}^{gT}\mathbf{M}_g + \varepsilon^{\alpha^g}. \quad (1)$$

The coefficients of interest were elements of the vector $\boldsymbol{\alpha}_2$ associated with the key measures. The coefficient on CTE enrollment can be interpreted as the expected change in the number of unexcused absences associated with enrollment in a CTE course in grade g, conditional on the controls in $\mathbf{X}_g$. Likewise, the coefficients on the indicators of inclusion can be interpreted as the expected change in unexcused absences associated with each level of inclusion in grade g, all else equal.

The other high school outcome that we considered was student on-time graduation. We modeled the probability that a student graduated on time, GR, as a function of student control variables in grade g, $\mathbf{X}_g$, and key measures in grade g, $\mathbf{M}_g$:

$$f\left(\Pr(GR=1)\right) = \beta_0{}^g + \beta_1{}^{gT}\mathbf{X}_g + \beta_2{}^{gT}\mathbf{M}_g + \varepsilon^{\beta^g}. \quad (2)$$

In our primary specification of Model 2 (and Model 3), we used the identity function for f and estimated these regressions as linear probability models. Thus, the coefficients of the vector $\boldsymbol{\gamma}_2$ represent the expected change in the probability of graduating on time associated with each key measure in grade g.

We used our measures of postsecondary success as outcome variables in models that addressed our second research question. The models predicting each postsecondary outcome PS (college enrollment or graduation) were similar to Model 2:

$$f\left(\Pr(PS=1)\right) = \gamma_0{}^g + \gamma_1{}^{gT}\mathbf{X}_g + \gamma_2{}^{gT}\mathbf{M}_g + \varepsilon^{\gamma^g} \quad (3)$$

The coefficients in $\boldsymbol{\gamma}_2$ represent the expected change in the probability of each postsecondary outcome associated with each key variable in grade g, all else equal.

Results

Summary Statistics

Table 1 presents summary statistics for students in the two cohorts considered in this analysis. For the purposes of comparison, we present summary statistics for the primary sample of students with learning disabilities ("SLD") alongside summary statistics for students who were not receiving special education services ("non-SPED") and students who were receiving special education services for a different disability ("non-SLD"). Panel A of Table 1 shows that students with learning disabilities were less likely to be female (39.1%) relative to students without disabilities (51.3%) and more likely to be female relative to students with other disabilities (30.4%). Students with learning disabilities were also more likely to be an underrepresented minority (34.3% vs. 20.2% and 20% for non-SPED and non-SLD, respectively), were more likely to be limited English proficient (19.6% vs. 15% and 8.9% for non-SPED and non-SLD), and were more likely to receive free or reduced-price lunch (60.9% vs. 35.9% and 48.2% for non-SPED and non-SLD). Panel B of Table 1 illustrates that students with disabilities (SLD and non-SLD) have much lower levels of baseline achievement than students without disabilities, with gaps ranging from approximately 1.2 to 1.5 *SD*.

The sample appeared to generalize well to other populations within the United States in that the demographics are similar to research by Wagner et al. (2016), who used the National Longitudinal Transition Study–2 to study a nationally representative sample of students with learning disabilities transitioning from high school. For example, Wagner et al. reported that 67.9% of their sample were male and 61.7% were white (vs. 60.9% and 65.7% in our setting, respectively). In terms of student poverty, about 33.6% of the sample of Wagner et al. lived in households with incomes ≤$25,000. This is more difficult to compare with our study because our primary measure of student poverty (free or reduced-price lunch eligibility) depends on the number of children in the family, but the requirements were roughly similar in 2012–2013: free meals for annual earnings <$19,669 for a family of two and reduced-price meals for annual earnings <$27,990. By this measure, our sample is somewhat more disadvantaged than that in the Wagner et al. study, as 60.9% of students with learning disabilities in our sample were eligible for free or reduced-price lunch.

Panels C and D of Table 1 focus on the key measures in this study (CTE enrollment and inclusion). The summary statistics in Panel C show that 73.2% of students with

Table 1. Summary Statistics: Student Covariates.

Variables	Non-SPED	SPED	
		SLD	Non-SLD
A: Demographics			
Proportion female	0.513	0.391	0.304
Proportion underrepresented minority	0.202	0.343	0.200
Proportion limited English proficiency	0.150	0.196	0.089
Proportion receiving free or reduced-priced lunch	0.359	0.609	0.482
B: Baseline test scores			
Average standardized eighth-grade math score	0.220	−1.259	−1.092
Average standardized eighth-grade reading score	0.213	−1.286	−1.137
Average standardized eighth-grade science score	0.217	−1.173	−1.017
C: Enrollment in CTE			
Proportion enrolled in CTE course in 12th grade	0.671	0.732	0.625
Proportion enrolled in concentration of CTE courses	0.275	0.357	0.288
D: Extent of inclusion			
Proportion 80% to 100% general education in 12th grade	0	0.522	0.398
Proportion 40% to 79% general education in 12th grade	0	0.441	0.383
Proportion 0% to 39% general education in 12th grade	0	0.032	0.197
Proportion other school setting in 12th grade	0	0.005	0.021

Note. CTE = career and technical education; SLD = specific learning disability; SPED = special education.

learning disabilities were enrolled in a CTE course in 12th grade, which is higher than the percentage of non-SPED students (67.1%) and non-SLD students (62.5%). As discussed earlier, 35.7% of students with learning disabilities were enrolled in a concentration of CTE courses in high school, which is also higher than the corresponding percentage of non-SPED students (27.5%) and non-SLD students (28.8%). Panel D of Table 1 shows that 52.2% of students with learning disabilities spent at least 80% of the school day in general education classes, whereas 44.1% of students with learning disabilities spent between 40% and 79% of the school day in general education classrooms. Not surprising, these rates of inclusion were higher than corresponding rates for non-SLD students (39.8% and 38.3%, respectively).

Table 2 contains summary statistics for the key outcome measures in this study. Panel A of Table 2 illustrates that students with learning disabilities had, on average, more unexcused absences than students without disabilities and students receiving special education services for a different disability. Panel B of Table 2 reports on-time graduation statistics; for example, 80.7% of 12th graders with a diagnosed learning disability graduated on time, as opposed to 92.0% of students without disabilities and 62.5% of students receiving special education services for a different disability.

Panels C and D of Table 2 focus on postsecondary outcomes. According to Panel C, the 2-year community college enrollment rates of on-time graduates were similar for high school graduates with learning disabilities and students without disabilities (18.6% vs. 22.1%), but the 4-year college enrollment rates of high school graduates varied considerably by disability status: 2.7% for high school graduates with learning disabilities and 22.0% for high school graduates without disabilities. Panel D presents employment statistics for students by disability status and illustrates that students with learning disabilities who graduated on time were less likely to be employed 6 months after their expected graduation date than were students not receiving special education services (12.6% vs. 17.9%).

Relationships Between CTE Enrollment and Inclusion and Student Outcomes

Our preferred specification for each model included district fixed effects (i.e., in which students were compared with other students within the same district). We focused on this specification for two reasons. First, given disparities in college attendance and employment rates across different geographical areas of Washington State (e.g., Washington Higher Education Coordinating Board, 2012), we believed that it was important to make comparisons among students who had similar geographical access to these postsecondary options. Second, although models with school fixed effects have the additional advantage of controlling for school-level factors that may have influenced student outcomes, they make comparisons exclusively among students within the same school, which may not be the relevant comparison for policy purposes. In particular, we believe that interventions

Table 2. Summary Statistics: Student Outcomes.

		SPED	
Variables	Non-SPED	SLD	Non-SLD
A: Student absences			
Average number unexcused absences in 10th grade	1.033	1.859	1.706
Average number unexcused absences in 11th grade	2.054	3.875	3.191
Average number unexcused absences in 12th grade	3.877	6.71	4.935
B: Student graduation			
Proportion 12th graders graduating on time	0.920	0.807	0.625
Proportion 10th-grade cohort graduating on time	0.838	0.678	0.515
Five-year graduation rate for 12th graders	0.948	0.894	0.746
Five-year graduation rate for 10th-grade cohort	0.876	0.765	0.638
C: College attendance within 1 year of expected graduation date			
Proportion on-time graduates in 2-year college	0.221	0.186	0.202
Proportion on-time graduates in 4-year college	0.220	0.027	0.050
Proportion of original cohort in 2-year college	0.199	0.137	0.122
Proportion of original cohort in 4-year college	0.185	0.019	0.026
D: Employment within 6 months of expected graduation date			
Proportion on-time graduates employed at least half time	0.179	0.126	0.089
Proportion of original cohort employed at least half time	0.166	0.105	0.055

Note. SLD = specific learning disability; SPED = special education.

related to the key measures considered in this study would likely be done at the school level, so we wanted to ensure that our primary results reflected cross-school as well as within-school relationships. We considered both models without district fixed effects and models with school fixed effects later in this section.

Table 3 presents the relationships between CTE enrollment and inclusion in 10th, 11th, and 12th grades and intermediate and postsecondary outcomes for students with learning disabilities from our preferred specifications of the models described earlier. The first column of Table 3 presents estimates of the relationships between CTE enrollment and inclusion in 10th grade and intermediate and postsecondary outcomes for students with learning disabilities. The first broad conclusion is that CTE enrollment in 10th grade was not consistently predictive of any of the outcomes of interest. In contrast, students with learning disabilities who were included in mostly general education courses (80% to 100%) in 10th grade were more likely to graduate on time (by approximately 3.1 percentage points) and were more likely to enroll in college in the 6 months after their expected graduation year (by approximately 2.5 points) than students with learning disabilities who spent less time in general education courses but were similar in other observable ways.

The second column of Table 3 presents estimates of the relationships between CTE enrollment and inclusion in 11th grade and subsequent outcomes. As in 10th grade, there is little evidence relating CTE enrollment in 11th grade to these outcomes, although students with learning disabilities who were enrolled in a CTE course in 11th grade had slightly fewer absences than did observably similar students who were not enrolled in a CTE course in 11th grade but were also less likely to enroll in college. Also similar to the results from 10th grade, students with learning disabilities who spent more time in general education courses in 11th grade were more likely to graduate on time and enroll in college—and, at this grade level, also more likely to find employment—than were students with learning disabilities who spent less time in general education courses in 11th grade, all else equal.

In the third column of Table 3, we turn to the relationships between CTE enrollment and inclusion in 12th grade and intermediate and postsecondary outcomes. At this grade level, we found consistent evidence that CTE enrollment was positively predictive of on-time graduation; specifically, students with learning disabilities who participated in a CTE course in 12th grade were approximately 3 to 4 percentage points more likely to graduate at the end of the year than students with learning disabilities who did not participate, all else equal. However, CTE enrollment in 12th grade did not predict employment. Inclusion in 12th grade was positively predictive of on-time graduation and college enrollment, although the magnitudes were smaller than in 11th grade; students with learning disabilities who spent 80% to 100% of the school day in general education classes in 12th grade were 4.3 percentage points more likely to graduate on time and 2.7 percentage points more likely to enroll in college than were students with learning disabilities who spent less time in general education classrooms, all else equal.

Table 3. Regression Results for Grades 10, 11, and 12.

	Grade		
Variables	10	11	12
A: Predicting number of absences			
Enrolled in a CTE course	−0.036	−0.082+	0.090
	(0.031)	(0.045)	(0.056)
80%–100% general education	−0.001	−0.059	−0.080
	(0.030)	(0.042)	(0.060)
Students, *n*	5,478	4,365	3,708
B: Predicting on-time graduation			
Enrolled in a CTE course	−0.009	−0.004	0.033+
	(0.016)	(0.015)	(0.019)
80%–100% general education	0.031+	0.067***	0.043**
	(0.016)	(0.017)	(0.014)
Students, *n*	5,122	4,211	3,659
C: Predicting enrollment in college			
Enrolled in a CTE course	−0.005	−0.029+	−0.010
	(0.012)	(0.015)	(0.018)
80%–100% general education	0.025+	0.041**	0.027+
	(0.014)	(0.014)	(0.017)
Students, *n*	5,122	4,211	3,659
D: Predicting employment			
Enrolled in a CTE course	0.017	−0.012	−0.007
	(0.011)	(0.013)	(0.016)
80%–100% general education	0.000	0.035**	0.016
	(0.011)	(0.013)	(0.014)
Students, *n*	5,122	4,211	3,659

Note. All models control for lagged absences, race/ethnicity, gender, bilingual, housing, migrant, English language learning, highly capable/gifted, home school status, a cubic polynomial of eighth-grade Washington Assessment of Student Learning scores, number of years diagnosed with a learning disability since seventh grade, and peer effects and include a district fixed effect. Standard errors are clustered at the school level; *p* values are based on a two-sided *t* test. CTE = career and technical education.
$^{+}p < .10$. $^{**}p < .01$. $^{***}p < .001$.

We pursued two sets of extensions and robustness checks to the results discussed earlier. First, we estimated all models reported in Table 3 both without district fixed effects and with school fixed effects to check the robustness of our findings to these different modeling decisions. We found that the inclusion results were robust to different modeling decisions; in other words, the consistent positive relationships between inclusion and measures of success for students with learning disabilities held across all of these additional model specifications. In contrast, results for CTE enrollment tended to vary across different specifications. Models with school fixed effects tended to suggest more positive relationships between CTE enrollment and student outcomes than models without school or district fixed effects. This sensitivity may imply that schools that offered more CTE courses also tend to have worse student outcomes, although as discussed earlier, this could be caused by schools with already lower aggregated outcomes choosing to offer more CTE courses or due to the effect of schoolwide CTE course offerings.

As a second extension, we followed Wagner et al. (2016) and considered whether students with learning disabilities were enrolled in a "concentration" of CTE courses in high school. We also created an analogous measure for inclusion by counting the number of years that a student spent in the highest level of inclusion (80%–100% general education) between Grades 10 and 12. Table 4 presents results from models that used the concentration variables described earlier as predictors of the same postsecondary outcomes considered in Table 3. We found consistent evidence that students with learning disabilities who were enrolled in a concentration of CTE courses were more likely to be employed after their expected graduation date (by about 3 percentage points) than were students with learning disabilities who were similar in terms of characteristics and baseline student achievement but not enrolled in a concentration of CTE courses. This replicated a subset of the findings in the Wagner et al. study and supported this prior evidence that a concentration of CTE courses is predictive of postsecondary outcomes for students with learning disabilities. The results

Table 4. Cumulative Regression Results.

Variables	Model 1	Model 2	Model 3
A: Predicting enrollment in college in 6 months after expected graduation year			
Four or more CTE credits in high school	−0.002		−0.003
	(0.018)		(0.018)
80%–100% general education: 1 year		0.031	0.031
		(0.025)	(0.025)
80%–100% general education: 2 years		−0.009	−0.009
		(0.026)	(0.026)
80%–100% general education: 3 years		0.057*	0.057*
		(0.026)	(0.026)
Students, *n*	2,568	2,568	2,568
B: Predicting employment in 6 months after expected graduation year			
Four or more CTE credits in high school	0.029+		0.028+
	(0.015)		(0.015)
80%–100% general education: 1 year		0.008	0.007
		(0.022)	(0.022)
80%–100% general education: 2 years		0.042+	0.042+
		(0.023)	(0.023)
80%–100% general education: 3 years		0.037	0.036
		(0.023)	(0.023)
Students, *n*	2,568	2,568	2,568

Note. All models control for lagged absences, race/ethnicity, gender, bilingual, housing, migrant, English language learning, highly capable/gifted, home school status, a cubic polynomial of eighth-grade Washington Assessment of Student Learning scores, number of years diagnosed with a learning disability since seventh grade, and peer effects and include a district fixed effect. Standard errors are clustered at the school level; *p* values are based on a two-sided *t* test. CTE = career and technical education.
$^{+}p < .10$. $^{*}p < .05$.

for inclusion further supported the relationships described in Table 3; specifically, students with learning disabilities who were in the highest level of inclusion in Grades 10 to 12 were about 6 percentage points more likely to enroll in college than were students with learning disabilities who were not in the highest level of inclusion in any of these grades, all else equal.

Discussion

Our results suggest that CTE concentration and inclusion are strongly associated with long-term outcomes for students with learning disabilities. On a national level, much of special education policy is motivated by the persistent gaps in student outcomes between students with and without disabilities, and we have shown that these gaps are also present in Washington State. But we have also shown that CTE concentration and inclusion are associated with better outcomes for students with learning disabilities and that the size of these associations are large relative to gaps in outcomes. For example, we found that CTE concentration and inclusion were associated with a 3– to 4–percentage point increase in the likelihood of on-time graduation relative to an 11–percentage point gap. Similarly, CTE concentration and inclusion were associated with a 2.8– to 4.2–percentage point increase in employment relative to a 5.3–percentage point gap, and inclusion was associated with 5.7–percentage point increase in college enrollment relative to a 19.3% gap.

That said, it is important to be cautious about the interpretation of our findings. We estimated analytic models intended to create "apples to apples" comparisons among students with learning disabilities who had similar baseline levels of achievement, other observable characteristics, and (in some specifications) attendance in the same district or school, but these students may have been different in unobserved ways that were correlated with their high school experiences. For example, more career-oriented students with learning disabilities could have been more likely to enroll in more CTE courses relative to students with learning disabilities who were similar in observable ways who enrolled in fewer CTE courses, and this type of selection would bias our estimates of the impact of CTE enrollment on student outcomes if the observable characteristics in our models do not capture these unobserved factors. We pursued a number of extensions and robustness checks and found that they consistently supported our primary findings, but given that we cannot fully account for all the different potential sources of bias, we ultimately viewed our results as descriptive.

However, we believe that our models contain sufficient controls (particularly for baseline achievement and peer effects)—and that the results from these models are sufficiently robust to different extensions and robustness checks—to warrant some preliminary conclusions. As a prime example, the relationships between inclusion and subsequent outcomes are so consistent, within this article and with prior research (e.g., Wagner, 1991), that we interpret these relationships as strong evidence that students with learning disabilities receive benefits from greater participation in general education classrooms that affect their future outcomes. The policy implications of this conclusion are straightforward and consistent with the foundation of special education law guaranteeing services for students with disabilities "in the least restrictive environment possible" (Individuals with Disabilities Education Act, 2012).

The results relating CTE enrollment to these outcomes are not consistent when participation is captured by whether a student is enrolled in a CTE course in a particular grade. In contrast, we find that the concentration of CTE enrollment across high school grades is positively predictive of intermediate and long-term outcomes for students with learning disabilities, which closely matches the findings from Wagner et al. (2016). This extension and prior research on the importance of specific aspects of CTE programs (Gottfried, Bozick, Rose, & Moore, 2016; Plasman & Gottfried, 2016) suggest that more nuanced research on particular aspects of CTE participation, particularly for students with learning disabilities—for example, CTE courses in STEM fields (science, technology, engineering, and mathematics)—could be a promising line of future work.

The remaining and potentially most daunting task is to address the potential sources of bias discussed earlier. The reality that even large, carefully controlled studies like this may not permit causal conclusions motivates the need for more large-scale, system-level experimental research in special education. Much has been written about the logistical and potential ethical concerns about experimental designs in special education research (e.g., Mertens & McLaughlin, 2004), and it is clear that the individualized nature of special education services makes large-scale research interventions particularly challenging. However, it is equally clear that the field of special education could benefit tremendously from large-scale experimental evidence that builds on rigorous descriptive analyses like this study. We therefore view this analysis as an important first step toward developing this evidence base, but we urge further research that can provide more plausibly causal evidence about what works for students with learning disabilities.

Finally, the field would benefit from more research that leverages new state-level administrative data systems, like the one used in this study, to perform large-scale studies on students with learning disabilities. It is surprising that, given the large administrative databases being developed and used throughout the country, this study is the first to use a statewide longitudinal database to link course taking and inclusion in high school to postsecondary outcomes for students with learning disabilities. Similar research in other states could provide important information about the extent to which these results hold across different educational settings.

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References

Affleck, J. Q., Edgar, E., Levine, P., & Kortering, L. (1990). Postschool status of students classified as mildly mentally retarded, learning disabled, or nonhandicapped: Does it get better with time? *Education & Training in Mental Retardation*, *25*(4), 315–324.

Baer, R. M., Flexer, R. W., Beck, S., Amstutz, N., Hoffman, L., Brothers, J., . . . Zechman, C. (2003). A collaborative follow up study on transition service utilization and post-school outcomes. *Career Development for Exceptional Individuals*, *26*(1), 7–25.

Benz, M. R., Lindstrom, L., & Yovanoff, P. (2000). Improving graduation and employment outcomes of students with disabilities: Predictive factors and student perspectives. *Exceptional Children*, *66*(4), 509–529.

Gottfried, M. A., Bozick, R., Rose, E., & Moore, R. (2016). Does career and technical education strengthen the STEM pipeline? Comparing students with and without disabilities. *Journal of Disability Policy Studies*, *26*(4), 232–244.

Haber, M. G., Mazzotti, V. L., Mustian, A. L., Rowe, D. A., Bartholomew, A. L., Test, D. W., & Fowler, C. H. (2016).

What works, when, for whom, and with whom: A meta-analytic review of predictors of postsecondary success for students with disabilities. *Review of Educational Research*, *86*(1), 123–162.

Harvey, M. W. (2002). Comparison of postsecondary transitional outcomes between students with and without disabilities by secondary vocational education participation: Findings from the national education longitudinal study. *Career Development for Exceptional Individuals*, *25*(2), 99–122.

Hasazi, S. B., Gordon, L. R., & Roe, C. A. (1985). Factors associated with the employment status of handicapped youth exiting high school from 1979 to 1983. *Exceptional Children*, *51*(6), 455–477.

Heal, L. W., & Rusch, F. R. (1995). Predicting employment for students who leave special education high school programs. *Exceptional Children*, *1*(5), 472–487.

Individuals with Disabilities Education Act, 20 U.S.C. §§ 1401 *et seq*. (2012).

Individuals with Disabilities Education Improvement Act of 2004, 20 U.S.C. § 612 (2004).

Karpinski, M. J., Neubert, D. A., & Graham, S. A. (1992). Follow-along study of postsecondary outcomes for graduates and dropouts with mild disabilities in a rural setting. *Journal of Learning Disabilities*, *25*(6), 376–385.

Mazzotti, V. L., Rowe, D. R., Sinclair, J., Poppen, M., Woods, W. E., & Shearer, M. L. (2016, November). Predictors of post-school success: A systematic review of NLTS2 secondary analyses. *Career Development and Transition for Exceptional Individuals*, *39*(4), 196–215.

Mertens, D. M., & McLaughlin, J. A. (2004). *Research and evaluation methods in special education*. Thousand Oaks, CA: Corwin Press.

Mithaug, D. E., Horiuchi, C. N., & Fanning, P. N. (1985). A report on the Colorado statewide follow-up survey of special education students. *Exceptional Children*, *51*(5), 397–404.

Newman, L., Wagner, M., Cameto, R., Knokey, A.-M., & Shaver, D. (2010). *Comparisons across time of the outcomes of youth with disabilities up to 4 years after high school. A report of findings from the National Longitudinal Transition Study (NLTS) and the National Longitudinal Transition Study–2 (NLTS2)* (Publication No. 2010-3008). Washington, DC: National Center for Special Education Research.

Plasman, J. S., & Gottfried, M. A. (2016). Applied STEM coursework, high school dropout rates, and students with learning disabilities. *Educational Policy*. Advance online publication. doi:0895904816673738

Rea, P. J., McLaughlin, V. L., & Walther-Thomas, C. (2002). Outcomes for students with learning disabilities in inclusive and pullout programs. *Exceptional Children*, *68*(2), 203–223.

Sitlington, P. L., & Frank, A. R. (1990). Are adolescents with learning disabilities successfully crossing the bridge into adult life? *Learning Disability Quarterly*, *13*(2), 97–111.

Test, D. W., Mazzotti, V. L., Mustian, A. L., Fowler, C. H., Kortering, L., & Kohler, P. (2009). Evidence-based secondary transition predictors for improving postschool outcomes for students with disabilities. *Career Development for Exceptional Individuals*, *32*(3), 160–181.

Wagner, M. (1991). *Youth with disabilities: How are they doing? The first comprehensive report from the National Longitudinal Transition Study of Special Education Students*. Menlo Park, CA: SRI International. Retrieved from http://files.eric.ed.gov/fulltext/ED341228.pdf

Wagner, M. (1992). *What happens next? Trends in postschool outcomes of youth with disabilities. The second comprehensive report from the National Longitudinal Transition Study of Special Education Students*. Menlo Park, CA: SRI International. Retrieved from http://files.eric.ed.gov/fulltext/ED356603.pdf

Wagner, M. (1993). *Beyond the report card: The multiple dimensions of secondary school performance of students with disabilities. A report from the National Longitudinal Transition Study of Special Education Students*. Menlo Park, CA: SRI International. Retrieved from http://files.eric.ed.gov/fulltext/ED365088.pdf

Wagner, M., Newman, L., Cameto, R., Levine, P., & Garza, N. (2006). *An overview of findings from Wave 2 of the National Longitudinal Transition Study–2 (NLTS2)* (Publication No. 2006-3004). Washington, DC: National Center for Special Education Research.

Wagner, M. M., Newman, L. A., & Javitz, H. S. (2016). The benefits of high school career and technical education (CTE) for youth with learning disabilities. *Journal of Learning Disabilities*, *49*(6), 658–670.

Washington Higher Education Coordinating Board. (2012). *Key facts about higher education in Washington*. Olympia, WA: Author. Retrieved from http://wsac.wa.gov/sites/default/files/KeyFacts2012.pdf