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High School English Language Arts Teachers and Postsecondary Outcomes for Students With and Without Disabilities

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Abstract

We used longitudinal data on high school students in Washington State to assess the relationships between English Language Arts (ELA) teacher qualifications and the high school and postsecondary outcomes of their students, and whether these relationships differed for students with and without disabilities. We found that students assigned to 10th-grade ELA teachers with higher value added had better test scores, were more likely to graduate on-time, and were more likely to attend and graduate from a 4-year college than observably similar students assigned to 10th-grade ELA teachers with lower value added. We also found that many of these relationships varied for students with and without disabilities, as 10th-grade ELA teacher value added was more positively predictive of on-time graduation and 4-year college attendance for students without disabilities, but more positively predictive of 2-year college attendance and employment within 2 years of graduation for students with disabilities.

Keywords

transition, policy, employment

A growing literature that uses large-scale administrative data sets from U.S. public schools suggests that teacher quality is the most important school factor in determining outcomes for public school students. However, due to data availability and testing schedules in most states, the vast majority of this research focuses on the relationships between teacher quality and student test outcomes at the elementary and middle school levels. Thus, while there has been some research investigating the impact of high school teachers on student test scores (e.g., Harris & Sass, 2011) and other influential research connecting teachers in elementary and middle schools to postsecondary outcomes such as graduation and employment (e.g., Chamberlain, 2013; Chetty et al., 2014b), researchers have only recently begun investigating the relationships between high school teacher characteristics and the postsecondary outcomes of their students (e.g., Lee, 2018).

Relatedly, empirical evidence on the distribution of teacher quality generally finds that disadvantaged public school students tend to be taught by less qualified and lower-quality teachers than their more-advantaged peers (e.g., Goldhaber et al., 2015, 2018; Clotfelter et al., 2005; Lankford et al., 2002). These teacher quality gaps are important because these types of teacher qualifications have been shown to predict student K–12 outcomes. These relationships tend to be strongest for teacher value added (e.g., Chetty et al., 2014a, 2014b), but students also tend to score lower on standardized tests, all else equal, when they are taught by a novice teacher (e.g., Rockoff, 2004) or a teacher with lower licensure test scores (e.g., Goldhaber, 2007; Clotfelter et al., 2007).

Researchers have recently begun extending this prior work to investigate the distribution and importance of teachers specifically for students with disabilities. For example, a recent paper using data from North Carolina (Gilmour & Henry, 2018) investigated the distribution of teacher qualifications in upper elementary and middle school math classrooms between students with disabilities and students without disabilities. The authors found little evidence that students with disabilities are systematically assigned to less qualified math teachers at these grade levels.

This study also builds on prior work from Florida (Feng & Sass, 2013) that investigated the relationship between various teacher qualifications and the test achievement of

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students with disabilities in Grades 4 to 10. The authors found that students with disabilities tended to perform better on both math and reading tests when they received instruction from a teacher who was certified in special education and scored higher in math when they received instruction from a teacher with an advanced degree. The authors also reported that these relationships often differed from the relationships for students without disabilities; for example, students without disabilities actually performed slightly worse when they were taught by a teacher certified in special education, all else equal.

This analysis is most closely related to a pair of unpublished papers by the same authors (Feng & Sass, 2010, 2012) that considered teacher qualifications as predictors of high school and postsecondary outcomes of students with disabilities in Florida. Both papers reported some significant relationships between teacher experience and degree level and student persistence and graduation from high school; for example, students with disabilities who were taught by a more experienced teacher were less likely to drop out of high school, all else equal. Feng and Sass (2010) also reported that students with disabilities who were taught by a teacher certified in special education were less likely to find employment after graduation.

The focus on postsecondary outcomes for students with disabilities in this article was motivated by a large literature documenting large and persistent gaps in K–12 and postsecondary outcomes between students with disabilities and students without disabilities in U.S. public schools. Much of this literature that includes data on postsecondary outcomes such as college attendance and employment uses data from two waves of the National Longitudinal Study of Special Education Students and reports that students with disabilities have lagged behind other public school students in terms of these measures of postsecondary success for at least the past several decades (e.g., Newman et al., 2010; Wagner, 1992).

Finally, this study is related to a much broader literature that investigates predictors of high school and postsecondary outcomes for students with disabilities. These papers are the topic of several recent reviews and meta-analyses (e.g., Haber et al., 2016; Mazzotti et al., 2016) that concluded that participation in career and technical education (CTE) and inclusion in general education are particularly predictive of college attendance and employment of students with disabilities. As a recent example, prior work with the same data set from Washington State described in this article (Theobald et al., 2019) found that students with learning disabilities who are enrolled in a "concentration" of CTE courses and who spend more time in general education courses experience better long-term outcomes than students with learning disabilities who are similar in other observable ways but are enrolled in fewer CTE courses or spend less time in general education classrooms.

This analysis used the same comprehensive, longitudinal administrative data on public school students in Washington State to explore the relationships between the characteristics of high school English Language Arts (ELA) teachers and the high school and postsecondary outcomes of their students with and without disabilities. This research was possible because of a unique system of Washington state datasets that includes detailed information about students' K–12 teachers and tracks students through the state's K–12 system and into the state's 2-year colleges, 4-year colleges, and workplaces. We used this data set to investigate three broad research questions:

Research Question 1: Are high school students with disabilities taught by lower-quality or less qualified ELA teachers (as measured by value added, experience, degree level, and subject-area endorsements) relative to their peers without disabilities?

Research Question 2: Do ELA teacher characteristics predict the high school outcomes (absences, test scores, and high school graduation) and postsecondary outcomes (2-year and 4-year college attendance/graduation and employment) of their students?

Research Question 3: Do these relationships differ for students with and without disabilities?

We focused on students receiving ELA instruction in 10th grade from a single regular education teacher in a class in which less than half of students are receiving special education services in a given year. Our focus on ELA regular education teachers in 10th grade was motivated by our interest in estimating the associations between teacher characteristics and student outcomes in classrooms that included both students with and without disabilities. This was possible due to the high proportion of students with disabilities who participate in general education classrooms in Washington (Theobald et al., 2019), though this comparison did not allow us to consider teachers who are funded through special education teaching positions. Moreover, we focused on ELA instruction because there was a consistent 10th-grade ELA testing regime during our study period, which allowed us to estimate value-added models of teacher effectiveness, while the high school math testing regime changed considerably during this time period.

Among these students, we found little evidence that students with disabilities were taught by lower-quality or less qualified teachers; in particular, we found no significant differences in average value added or the proportion of novice teachers or teachers with an advanced degree between the ELA teachers of students with and without disabilities. This echoed findings in Gilmour and Henry (2018) that the distribution of teacher qualifications between students with disabilities and students without disabilities in late elementary and middle school math classrooms was relatively equitable in North Carolina Public Schools.

When we investigated the relationships between ELA teachers' qualifications and the longer-term outcomes of their students, we found that students assigned to 10th-grade ELA teachers with higher value added had better test scores, were more likely to graduate on time, and were more likely to attend and graduate from a 4-year college than observably similar students assigned to 10th-grade ELA teachers with lower value added. This contributes to a small literature (Chamberlain, 2013; Chetty et al., 2014b; Lee, 2018) that connects teachers' value added to the postsecondary outcomes of their students and is the first empirical evidence that demonstrates these relationships for individual high school teachers. We also found some evidence connecting assignment to novice ELA teachers and ELA teachers with advanced degrees to better outcomes on some measures. The evidence connecting novice ELA teachers to higher graduation and college attendance rates runs counter to evidence that students in lower grades who are assigned to novice teachers tend to have lower achievement, all else equal (e.g., Rockoff, 2004), though this is consistent with other evidence for high school teachers (e.g., Harris & Sass, 2011).

Finally, when we explored heterogeneity in these relationships for students with and without disabilities, we found considerable evidence that the relationships between ELA teacher value added and later outcomes varied for these two groups of students. Specifically, 10th grade ELA teacher value added was more positively predictive of on-time graduation and 4-year college attendance for students without disabilities, but more positively predictive of 2-year college attendance and employment within 2 years of graduation for students with disabilities. Finally, few of the other relationships varied for students with and without disabilities, and perhaps surprisingly given evidence from lower grade levels (Feng & Sass, 2013), we also found little evidence that students with disabilities disproportionately benefit from assignment to an ELA teacher with a special education endorsement.

Method

Data Sources and Study Sample

The data for this project were provided by Washington State's Education Research and Data Center (ERDC), a P–20 student data warehouse that combines administrative K–12 data with college and employment data. The high school data came from Washington State's Office of Superintendent of Public Instruction (OSPI). OSPI maintains the Comprehensive Education Data and Research System (CEDARS), a longitudinal data system introduced in the 2009–2010 school year. This data system links four primary files: a student enrollment and program file that includes detailed data about student demographics and special education services; a student schedule file that includes one entry for each student and course in which the student is enrolled; a teacher schedule file that includes one entry for each teacher and course the teacher is assigned to teach; and the Washington State S-275 personnel report that includes demographic, experience, and salary data for each teacher in the state. The teacher data in CEDARS were further linkable to the Washington Credential Database that contains information on teaching credentials and endorsements.

Although the CEDARS data system was introduced in the 2009–2010 school year, it can 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. Our primary measure of baseline performance came from Washington State's Student Testing Database, which includes eighth-grade test scores for all of our cohorts on the Washington Assessment of Student Learning (WASL) before 2009–2010 and the Measures of Student Progress (MSP) test since 2009–2010. The eighth-grade WASL and MSP are composed of subject-specific tests in science, reading, and math. All of the WASL and MSP scores have been standardized across all test takers within grade and year.

The data sets provided by ERDC connect students in CEDARS K–12 data set with data from the state's colleges: the Public Centralized Higher Education Enrollment System (PCHEES) for public, 4-year universities in Washington State and the State Board of Community and Technical Colleges (SBCTC) data system for public 2-year colleges in Washington State. An important caveat is that these data sets do not cover out-of-state colleges or in-state private colleges. The CEDARS K–12 data system can also be linked to the Unemployment Insurance (UI) records of all individuals employed in positions that pay UI in Washington State, including quarterly wages and an occupational code; that said, this database does not include any forms of employment for which individuals do not pay UI, such as military service or informal work experiences. The UI records are reported on a quarterly basis and run from 2010 through 2016 on the calendar year.

Because we had K–12 data between 2009–2010 and 2011–2012 linked to postsecondary data through 2015–2016, we were able to consider the relationships between teacher qualifications and postsecondary outcomes for students for three different cohorts of 10th-grade students, summarized in Table 1. After linking students to teachers via classroom identifiers, we further limited the dataset to ELA courses by using Washington State content area codes and course title names, and then limited the data set to students who were receiving ELA instruction from a single regular education teacher in 10th grade in a classroom in which less than 50% of the students were receiving special education services. As shown in Table 1, the final analytic

Table 1. Sample Sizes by Cohort and Disability Type.

	Cohort 1	Cohort 2	Cohort 3	
Student disability type	10th grade in 2009–2010	10th grade in 2010–2011	10th grade in 2011–2012	Total
No disability reported (non-SPED)	48,383	50,181	49,421	147,985
Specific learning disability	1,150	1,131	1,200	3,481
Health impairment	588	679	663	1,930
Communication disorders	113	186	223	522
Autism	120	155	151	426
Emotional/behavioral disability	81	135	135	351
Hearing impairment	21	19	22	298
Orthopedic impairment	12	12	17	98
Other disability	36	37	55	102
Total	50,504	52,535	51,887	154,926
Total with disabilities	2,121	2,354	2,466	6,941

Note. Sample sizes limited to students receiving ELA instruction from a single teacher in a given year and in a class with less than 50% students in SPED. "Other disability" category includes all disability categories (intellectual disability, multiple disabilities, traumatic brain injury, deafness, visual impairment, developmental delays, and deaf-blindness) with fewer than 10 students in a given cohort. SPED = special education; ELA = English Language Arts.

sample after these restrictions included 154,926 unique students and 6,941 students with disabilities, with specific learning disability and health impairment as the most common disability types.

Teacher Characteristics

The student–teacher links in the CEDARS data set allowed us to consider a number of different characteristics of the students' 10th-grade teachers. First, we estimated teacher value-added models from the following "leave-one-out" specification of teacher value added that has been shown to be an unbiased predictor of out-of-sample student performance (Chetty et al., 2014a). Specifically, we used the following procedure for students linked to a 10th-grade ELA test score. First, we created a residualized 10th-grade ELA test score for each student i with teacher j in year t by estimating the following regression:

$$Y_{ijt} = \alpha_j + \alpha_1 Y_{i(t-2)} + \alpha_2 X_{it} + \varepsilon_{ijt} \quad (1)$$

In the model in Equation 1, the outcome variable Y_{ijt} is the 10th-grade ELA-standardized test score for student i with teacher j in year t. The predictor variables include $Y_{i(t-2)}$, a vector of eighth-grade test scores in math, reading, and science; X_{it}, a vector of student and classroom characteristics in year t; and a teacher-fixed effect α_j. We used the estimated coefficients $\hat{\alpha}_1$ and $\hat{\alpha}_2$—which are estimated from within-teacher variation due to the presence of the teacher-fixed effect in Equation 1—to create the residualized test scores:

$$Y^*_{ijt} = Y_{ijt} - \hat{\alpha}_1 Y_{i(t-2)} - \hat{\alpha}_2 X_{it} \quad (2)$$

Y^*_{ijt} can be interpreted as a student's residual test score adjusting for the student's prior performance and observable characteristics.

We then used the mean residual scores for teacher j in year t, $\overline{Y^*_{jt}}$, to calculate the teacher value-added estimates. We first calculated forecasting coefficients, ψ_s, where s is the number of years between the observed school year and the forecasting target:

$$\psi = arg \min_{\{\psi_s\}} \sum_j \left(\overline{Y^*_{jt}} - \sum_{s \neq t} \psi_s \overline{Y^*_{js}} \right)^2 \quad (3)$$

In other words, we estimated the forecasting coefficients to minimize the mean-squared error of the forecasts (see Chetty et al. (2014a) for additional details).

Finally, we used the estimates $\hat{\psi}_s$ from Equation 3 and the mean residual scores $\overline{Y^*_{jt}}$ to calculate teacher value added in year t:

$$\hat{\tau}_{jt} = \sum_{s \neq t} \hat{\psi}_s \overline{Y^*_{jt}} \quad (4)$$

We refer to the estimates $\hat{\tau}_{jt}$ produced by this procedure as "leave-one-out" estimates of teacher value added because they use data on students linked to a teacher in all years other than year t to estimate value added in year t. Importantly, the lack of a ninth-grade test in Washington means that these estimates are based on gains from a twice-lagged test score, which implies that these 10th-grade ELA teacher value-added estimates combine the effectiveness of 10th-grade teachers with the effectiveness of their students' ninth-grade teachers.

This value-added approach also implicitly assumes that teachers have the same impact on the test scores of students with and without disabilities. We do not have sufficient sample sizes to estimate value-added models just for students with disabilities in this sample, but prior research suggests that value-added estimates that include and exclude students with disabilities are very highly correlated (Buzick & Jones, 2015), while value-added estimates from a broader panel of student-level data in Washington (Goldhaber et al., 2017) suggest that the correlation between value-added estimates based on all students and value-added estimates using just students with disabilities is more than .8. This helps justify our approach of using value-added estimates pooled across all students to predict outcomes for students with and without disabilities.

The other measures of teacher quality and qualifications came directly from the various data sources discussed above. First, we utilized information on teacher credentialing areas and endorsements from the Washington State credentials database; of particular interest was whether each student is taught by a teacher with an endorsement to teach special education. Finally, the S-275 data set contains the teaching experience and highest degree earned of each student's teacher. We constructed indicators for whether each teacher has fewer than 5 years of experience ("novice teacher") and whether the teacher possesses a master's degree or higher ("advanced degree").

Student Outcome Measures

The K–12 data system also provided data on each of the three high school outcomes we consider in this study: the number of unexcused absences in 10th grade, test scores on 10th-grade reading tests, and graduation from high school. First, the K–12 CEDARS student enrollment file includes the number of unexcused absences for each student in each year. Second, nearly every student in the sample took the High School Proficiency Exam (HSPE) test in reading at the end of 10th grade, so we considered these test scores as a second high school outcome. We standardized each of these outcomes within grade and year to create continuous outcome measures for models described below. Our final high school outcome was an indicator that the student graduated on time with a regular high school diploma, which we created from the CEDARS student enrollment files.

Finally, we considered three measures of postsecondary success for each student in the sample: enrollment in a 2-year college (from the SBCTC data described above), enrollment in a 4-year college (from the PCHEES data described above), and employment in the state workforce (from the UI data described above). For earlier cohorts, we also considered college graduation within 4 years of students' high school graduation date using completion files in the SBCTC and PCHEES data sets. For employment, we constructed an indicator from the UI data for being employed more than half time for each quarter after a student's expected graduation. We then took the maximum of these indicators to determine whether an individual was employed more than half time in any quarter within a given period after their expected graduation.

Summary Statistics

We present and discuss two sets of summary statistics calculated from the analytic data set described above. First, Table 2 provides summary statistics for each of the outcome measures that will be considered in the analytic models described below; these provide context for the magnitude of the relationships discussed in the next section. Because we disaggregate these summary statistics for students with disabilities ("SPED") and students without disabilities ("non-SPED"), comparisons between the last two columns of Table 2 illustrate the disparities in K–12 and postsecondary outcomes between students with disabilities and students without disabilities in these cohorts. Importantly, as described above, these results are limited to students receiving ELA instruction from a single regular education teacher in a given year and in a class with less than 50% of the students receiving special education services.

For nearly all of the outcomes presented in Table 2, there are statistically significantly differences between students with and without disabilities. Students with disabilities miss more days of school (about one additional day per year), score substantially lower on the HSPE in reading in 10th grade (by about 85% of a standard deviation), and are less likely to graduate on time with a regular diploma (by about 12 percentage points) than students without disabilities. Panel B of Table 2 illustrate that students with disabilities have lower rates of 4-year college attendance, graduation, and employment after graduation than students without disabilities in the sample. Finally, Panel B of Table 2 also illustrates that students without disabilities who graduate on time are about 9 percentage points more likely to be employed within 2 years of graduation than students with disabilities who graduate on time (30% vs. 21%).

In Table 3, we provide summary statistics for both student characteristics of interest and the various teacher characteristics discussed above. Panel A illustrates some important demographic and test score differences between students with disabilities and students without disabilities in the sample. Specifically, consistent with findings from other contexts (e.g., Coutinho & Oswald, 2005), students with disabilities were much less likely to be female, were more likely to be an underrepresented minority (American Indian, Black, or Hispanic), and were much more likely to be receiving free or reduced-price lunch than students without disabilities. The large differences between the eight-grade test performance of students with disabilities and students without disabilities also shown in Panel A (approximately a standard deviation in math, reading, and

Table 2. Student Outcome Summary Statistics.

Indicator	All students	Non-SPED	SPED
Panel A: Student absences, test performance, grade progression, and graduation			
Avg number unexcused absences in 10th grade	1.48	1.44	2.40***
	(5.13)	(5.02)	(7.09)
Avg standardized 10th-grade reading test score	0.29	0.33	−0.52***
	(0.88)	(0.86)	(0.89)
Proportion progressing to 11th grade	0.95	0.95	0.94***
Proportion graduating from high school on time	0.87	0.87	0.75***
Panel B: College attendance and employment			
Proportion in 2-year college within 2 years	0.36	0.36	0.35
Proportion in 4-year college within 2 years	0.23	0.24	0.07***
Proportion of Cohort 1 graduating from 2-year college	0.41	0.14	0.08***
Proportion of Cohort 1 graduating from 4-year college	0.09	0.10	0.01***
Proportion of original cohort employed at least half time	0.29	0.29	0.19***

Note. All summary statistics calculated only from cohorts with available data and limited to students receiving ELA instruction from a single teacher in a given year and in a class with less than 50% students in SPED. Standard deviations of continuous variables in parentheses. SPED = special education; Avg = average; ELA = English Language Arts.
p values from two-sided t test relative to non-SPED column: *$p < .05$. **$p < .01$. ***$p < .001$.

Table 3. Student Characteristics and Teacher Qualifications.

Indicator	All	Non-SPED	SPED
Panel A: Student demographics and test scores			
Proportion female	0.503	0.510	0.359***
Proportion underrepresented minority	0.205	0.203	0.242***
Proportion limited English proficiency	0.148	0.149	0.119***
Proportion receiving FRL	0.367	0.362	0.478***
Avg standardized eighth-grade math score	0.223	0.270	−0.759***
	(0.916)	(0.891)	(0.896)
Avg standardized eighth-grade reading score	0.216	0.258	−0.669***
	(0.862)	(0.836)	(0.921)
Avg standardized eighth-grade science score	0.224	0.264	−0.602***
	(0.893)	(0.873)	(0.916)
Panel B: 10th-grade ELA teacher characteristics			
Avg value-added score	0.001	0.001	0.001
	(0.054)	(0.054)	(0.053)
Proportion novice teachers (<5 years experience)	0.216	0.216	0.221
Proportion teachers with advanced degree	0.731	0.731	0.738
Proportion teachers with SPED endorsement	0.028	0.028	0.035***

Note. All summary statistics limited to students receiving ELA instruction from a single teacher in a given year and in a class with less than 50% students in SPED. SPED = special education; FRL = free or reduced-price lunch; Avg = Average; ELA = English Language Arts.
p values from two-sided t test relative to non-SPED column *$p < .05$. **$p < .01$. ***$p < .001$.

science) illustrate the stark difference in baseline academic performance between the two groups of students.

Comparisons between the last two columns of Panel B of Table 3 address Research Question 1: Are high school students with disabilities in Washington State taught ELA by more or less qualified teachers than their peers without disabilities? We find little evidence that students with disabilities receive ELA instruction from less qualified teachers. While this may be surprising given that students with disabilities are disproportionately students of color and recipients of free or reduced-price lunch and prior work has shown significant teacher quality gaps according to these other measures of disadvantage, this finding is somewhat consistent with Goldhaber et al. (2015), who find considerably smaller teacher quality gaps according to these teacher quality measures in 10th-grade ELA than in lower grade levels and subjects. Finally, only a small percentage of teachers in the sample hold special education endorsements, 2% to 4% depending on the grade, but students with disabilities are more likely to have a teacher with such an endorsement.

Overall, these results suggest that students with disabilities in Washington State perform worse than their peers without disabilities on virtually all measures, but are not taught by less effective teachers in terms of any of our measures of teacher qualifications. In the next section, we describe our analytic approach for estimating the associations between these teacher qualifications and student outcomes, and investigating whether these associations differ between students with and without disabilities.

Analytic Approach

Our analytic approach to investigating Research Questions 2 and 3 was to estimate a series of student-level models predicting the measures of high school and postsecondary student outcomes described above as a function of the various teacher quality measures described above, as well as baseline measures of student performance and other classroom covariates. While these models have a rich set of control variables, we still view these models as descriptive because our controls may not sufficiently address the possibility that students are assigned to different teachers according to unobserved factors that are also correlated with student outcomes. A broad literature has considered this potential source of bias in estimating the impacts of individual teachers on student test performance (e.g., Chetty et al., 2014a) and generally suggests that models that control for the prior performance of students and other observable student characteristics are sufficient to account for the nonrandom sorting of students to teachers. Given this evidence, we included controls for prior performance on eighth-grade WASL tests and other observable student characteristics (e.g., demographics and free/reduced-price lunch eligibility) in all of our specifications.

In addition, Jackson (2014) has shown that tracking at the high school level can bias the estimates from models that do not account for this clustering of similar students within the same classroom. Our primary solution to this potential source of bias, beyond the inclusion of extensive student-level controls in all models, was to include additional controls for the average characteristics of a student's classmates so that students are only compared with other students who are taking classes with observably similar students.

With these considerations in mind, we estimated a series of regression models across all students linked to a single regular education teacher and in a classroom with less than half of the students receiving special education services in 10th grade. We first considered predictors of student unexcused absences, one of the high school outcomes described in the Data section above. For each student in our analytic sample, we observe the number of unexcused absences in 10th grade, ABS_{10}. We modeled this outcome as a function of student control variables in Grade 10, $\boldsymbol{X}_{10}$, which also included indicators for each category of disability in our sample; the average characteristics of the student's ELA classmates in Grade 10, $\bar{\boldsymbol{X}}_{10}$; the observable characteristics of the student's ELA teacher in Grade 10, $\boldsymbol{T}_{10}$; and (in some specifications) an interaction between this teacher characteristic and an indicator for whether the student is receiving special education services in Grade 10, S_{10}:

$$ABS_{10} = \beta_0 + \beta_1 X_{10} + \beta_2 \bar{\boldsymbol{X}}_{10} + \beta_3 T_{10} + \varepsilon^{\beta} \quad (5a)$$

$$ABS_{10} = \beta_0 + \beta_1 X_{10} + \beta_2 \bar{\boldsymbol{X}}_{10} + \beta_3 T_{10} + \beta_4 T_{10} * S_{10} + \varepsilon^{\beta} \quad (5b)$$

The coefficients in the vector β_3 in the model in Equation 5a (that does not include the interaction term) address Research Question 2; these coefficients can be interpreted as the expected relationships between each teacher characteristic and the number of unexcused absences *for all students*, all else equal. When the interaction term is included in Equation 5b, the coefficients in β_4 can be interpreted as the differences in the relationship between students with disabilities and students without disabilities, and thus address Research Question 3: Are these relationships different for students with disabilities than for their peers without disabilities?

We estimated similar models for each of the other high school and postsecondary outcomes described above. We next modeled each student's reading test score $TEST_{10}$, as a function of the same terms in Equation 5, and estimated specifications that did and did not include the interaction term in parentheses:

$$TEST_{10} = \gamma_0 + \gamma_1 X_{10} + \gamma_2 \bar{\boldsymbol{X}}_{10} + \gamma_3 T_{10} \left(+ \gamma_4 T_{10} \times S_{10} \right) + \varepsilon^{\gamma} \quad (6)$$

Finally, we considered a series of binary outcome variables: on-time graduation, college enrollment and graduation, and employment. We modeled the probability of each of these outcomes O with the model in Equation 7, where $O = 1$ denotes a desirable outcome (i.e., graduation, college enrollment/graduation, or employment):

$$f\left(\Pr\left(O=1\right)\right) = \delta_0 + \delta_1 X_{10} + \delta_2 \bar{\boldsymbol{X}}_{10} + \delta_3 T_{10} \left(+ \delta_4 T_{10} \times S_{10} \right) + \varepsilon^{\delta} \quad (7)$$

In our primary specifications of the model in Equation 7, we used the identity function for *f* and estimate these regressions as linear probability models. Thus, the coefficients represent the expected change in the probability of each outcome associated with each control variable.

Results

Tables 4–6 present estimates from various specifications of the models described above. For a given table, each column presents results from a separate regression that is designed

Table 4. Grade 10 ELA Teacher Characteristics and High School Outcomes (All Cohorts).

	Outcome											
	Unexcused absences				10th-grade reading test				On-time graduation			
Teacher measure	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*
VA	−0.097	0.070	−0.085	0.069	0.979***	0.045	0.976***	0.046	0.095***	0.025	0.106***	0.025
VA × SPED			−0.320	0.295			0.050	0.188			−0.260*	0.130
Novice	0.025*	0.010	0.027**	0.010	−0.006	0.006	−0.007	0.006	0.009**	0.003	0.010**	0.003
Novice × SPED			−0.033	0.034			0.035	0.024			−0.014	0.018
Advanced degree	−0.009	0.009	−0.010	0.009	−0.006	0.005	−0.006	0.005	0.004	0.003	0.004	0.003
Advanced × SPED			0.021	0.031			−0.017	0.022			0.000	0.016
SPED endorsed	0.041	0.026	0.020	0.022	−0.011	0.014	−0.008	0.014	0.001	0.008	0.003	0.008
Endorsed × SPED			0.366*	0.143			−0.067	0.057			−0.027	0.034
No. of students	103,110	103,110	99,584	99,584	103,110	103,110	103,110	103,110	103,110	103,110	103,110	103,110

Note. All models control for lagged absences, race/ethnicity, gender, bilingual status, housing status, migrant status, English Language Learning status, highly capable/gifted status, home school status, a cubic polynomial of eighth-grade WASL scores, disability type, and average classroom variables. Standard errors are clustered at the classroom level. ELA = English Language Arts; VA = value added; SPED = special education.

p values from two-sided t test: *$p < .05$. **$p < .01$. ***$p < .001$.

Table 5. Grade 10 ELA Teacher Characteristics and Postsecondary Outcomes Within 2 Years of Expected Graduation (All Cohorts).

	Outcome											
	Two-year college attendance				Four-year college attendance				Employment within 2 years			
Teacher measure	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*
VA	−0.060†	0.033	−0.073*	0.034	0.132***	0.028	0.136***	0.029	−0.004	0.036	−0.012	0.037
VA × SPED			0.325*	0.137			−0.098	0.076			0.210†	0.120
Novice	−0.000	0.004	0.001	0.005	0.018***	0.004	0.017***	0.004	0.004	0.005	0.005	0.005
Novice × SPED			−0.018	0.020			0.008	0.011			−0.007	0.016
Advanced degree	0.009*	0.004	0.009*	0.004	−0.008*	0.003	−0.009*	0.004	−0.002	0.004	−0.003	0.004
Advanced × SPED			0.003	0.017			0.010	0.009			0.016	0.014
SPED endorsed	−0.007	0.011	−0.007	0.012	−0.017†	0.009	−0.017†	0.009	−0.007	0.012	−0.006	0.012
Endorsed × SPED			0.009	0.042			0.008	0.017			−0.017	0.033
No. of students	103,110	103,110	103,110	103,110	103,110	103,110	103,110	103,110	103,110	103,110	103,110	103,110

Note. All models control for lagged absences, race/ethnicity, gender, bilingual status, housing status, migrant status, English Language Learning status, highly capable/gifted status, home school status, a cubic polynomial of eighth-grade WASL scores, disability type, and average classroom variables. Standard errors are clustered at the classroom level. ELA = English Language Arts; VA = value added; SPED = special education.

p values from two-sided *t* test: †$p < .1$. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 6. Grade 10 ELA Teacher Characteristics and Postsecondary Outcomes Within 4 Years of Expected Graduation (Cohort 1).

	Outcome											
	Two-year college completion				Four-year college completion				Employment within 4 years			
Teacher measure	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*	Coefficient	*SE*
VA	−0.010	0.040	−0.010	0.041	0.076*	0.030	0.078*	0.031	−0.043	0.062	−0.038	0.063
VA × SPED			−0.038	0.141			−0.045	0.065			−0.045	0.230
Novice	0.005	0.005	0.005	0.005	0.010*	0.004	0.010*	0.004	0.009	0.008	0.009	0.008
Novice × SPED			0.008	0.019			−0.013	0.010			−0.006	0.032
Advanced degree	−0.005	0.005	−0.004	0.005	−0.004	0.004	−0.004	0.004	0.010	0.008	0.007	0.008
Advanced × SPED			−0.020	0.018			−0.003	0.009			0.071*	0.028
SPED endorsed	−0.014	0.012	−0.017	0.012	0.010	0.009	0.010	0.010	−0.006	0.019	−0.007	0.020
Endorsed × SPED			0.040	0.041			0.008	0.025			0.018	0.066
No. of students	34,249	34,249	34,249	34,249	34,249	34,249	34,249	34,249	34,249	34,249	34,249	34,249

Note. All models control for lagged absences, race/ethnicity, gender, bilingual status, housing status, migrant status, English Language Learning status, highly capable/gifted status, home school status, a cubic polynomial of eighth-grade WASL scores, disability type, and average classroom variables. Standard errors are clustered at the classroom level. ELA = English Language Arts; VA = value added; SPED = special education.

p values from two-sided *t* test: $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

to address Research Questions 2 and 3 for a given set of outcomes. Within each outcome, the first set of columns reports estimates and standard errors from the specification *without* an interaction term for students with disabilities (and thus addresses Research Question 2), whereas the second set of columns reports estimates and standard errors from the specification *with* an interaction term for students with disabilities (and thus addresses Research Question 3).

Tables 4 and 5 report the relationships between four ELA teacher characteristics in 10th grade (value added, novice, advanced degree, and special education [SPED] endorsement) and the six outcomes discussed in the previous section. The most striking finding is that 10th-grade ELA teacher value added is not only predictive of 10th-grade test scores, but also later student outcomes: on-time graduation and 4-year college enrollment. The nearly one-to-one correspondence between out-of-sample value added and student test score gains is consistent with prior work on teacher value added (e.g., Chetty et al., 2014a). And given that a one standard deviation of value added in our sample is about 0.05 standard deviations of student performance, the increase in the probability of attending a 4-year college associated with a one standard deviation increase in 10th-grade ELA teacher value added (0.68 percentage points) is similar to the comparable estimate for fourth- to eighth-grade teachers reported in Chetty et al. (2014b; 0.74 percentage points).

As shown in Table 5, 10th-grade ELA teacher value added is also negatively predictive of 2-year college attendance for the average student. This is perhaps counter-intuitive, but when we estimate separate models that drop students who attend a 4-year college, we do not find a significant association between 10th-grade ELA teacher value added and 2-year college enrollment. This suggests that students assigned to higher value-added teachers who are on the margin of attending a 2-year or 4-year college may be induced into enrolling in a 4-year rather than a 2-year college.

It is also striking how many of the relationships between 10th-grade ELA teacher value added and long-term outcomes vary for students with and without disabilities. Specifically, the negative interactions in the models predicting on-time graduation (Table 4) and 4-year college enrollment (Table 5) suggest that the relationships between 10th-grade ELA teacher value added and these outcomes are more positive for students without disabilities than for students with disabilities. On the contrary, the positive interactions in the models predicting 2-year college enrollment and employment (Table 5) suggest that the relationships between 10th-grade ELA teacher value added and these outcomes are more positive for students with disabilities than for students without disabilities. The fact that 10th-grade ELA teacher value added is negatively predictive of 2-year college enrollment for students without disabilities but positively predictive of 2-year college enrollment for students with disabilities is suggestive of differential "substitution effects" for students with disabilities; specifically, students with disabilities with more effective teachers may be more likely to attend a 2-year college than not attend college at all, whereas (as discussed above) students without disabilities with more effective teachers may be more likely to attend a 4-year college rather than a 2-year college.

Other teacher characteristics are far less predictive of student outcomes relative to value added, but a number of other relationships in Tables 4 and 5 are statistically significant, and not always in the expected directions. Specifically, students with novice 10th-grade ELA teachers tend to have more absences, all else equal, than students with non-novice 10th-grade ELA teachers, but are also more likely to graduate on-time and attend a 4-year college. Students with a 10th-grade ELA teacher with an advanced degree are also more likely to attend a 2-year college but less likely to attend a 4-year college. Finally, we find little evidence that 10th-grade ELA teachers with an SPED endorsement are associated with different outcomes for students with or without disabilities, and little evidence that any of these teacher characteristics are predictive of student employment after graduation.

A key strength of our administrative data is that we can observe college enrollment, completion, and employment outcomes for some students long after they leave high school. We explore these relationships further in Table 6 by considering outcomes 4 years after students' expected graduation date just for students in Cohort 1 (i.e., the only cohort with 4 years of postsecondary data). These results illustrate that 10th-grade ELA teacher value added is also highly predictive of the probability that students in this cohort *graduate* from a 4-year college. On the contrary, we find far less evidence of heterogeneity between students with and without disabilities in terms of the relationships between 10th-grade ELA teacher characteristics and these longer-term outcomes, though this could be explained by the lower power from the reduced sample sizes in this table.

Discussion

The findings from this article reinforce the importance of teachers for the long-term outcomes of students with and without disabilities and provide the first empirical evidence linking individual teacher value added at the high school level to student graduation, college attendance, and later employment outcomes. This research has important implications for the practice of special education, as it suggests that exposure to effective ELA teachers in a general education setting is associated with better outcomes for students both with and without disabilities. Considered in combination with earlier results using this same data set suggesting a strong positive association between inclusion in general education classrooms and better high school and postsecondary outcomes for students with disabilities (Theobald et al., 2019), these results provide empirical support for the foundation of special education law guaranteeing services for students with disabilities "in the least restrictive environment possible" (Individuals with Disabilities Education Act [IDEA], 20 U.S.C. §§ 1401 et seq. (2012)).

Our results also suggest that exposure to effective teachers is associated with different pathways for students with and without disabilities. In particular, these associations suggest that assignment to effective teachers may be particularly important for students with disabilities in terms of 2-year college attendance and postsecondary employment, but not for 4-year college enrollment (as it is for students without disabilities). More research is necessary to understand whether these are causal relationships and, if so, why effective teachers impact the future educational trajectories of students with and without disabilities differently.

These findings are also important for the field of special education because there is little empirical evidence about the extent to which the distribution of teacher quality, measured by value added or teacher qualifications, may contribute to the large and persistent gaps in high school and postsecondary outcomes between students with disabilities and students without disabilities. The results presented in this article provide little evidence to support the hypothesis that students with disabilities have less access to effective or qualified teachers in high school ELA general education classrooms in Washington. This suggests that the distribution of teacher qualifications in Washington high schools does not meaningfully contribute to gaps in longer-term outcomes between students with disabilities and students without disabilities in the state.

Finally, our results that consider college completion (rather than college enrollment) suggest that it is important for researchers to consider longer-run outcomes for students—and perhaps particularly for students with disabilities—than just college enrollment. Specifically, we find that 10th-grade ELA teacher value added is a significant predictor of 4-year college enrollment and completion, but there is a substantial decline in the relationship with college completion. Moreover, while we find that value added is positively predictive of *enrollment* into 2-year colleges for students with disabilities, we do not find that it predicts higher *completion* rates. We therefore encourage more research that considers the experiences of students with disabilities at the college level to shed light on additional factors that could improve completion rates for these students.

Authors' Note

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