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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 use longitudinal data on high school students in Washington State to assess the relationships between English Language Arts (ELA) teacher value added and other qualifications and the high school and postsecondary outcomes of their students. We also investigate whether these relationships differ for students with and without disabilities. We find that students assigned to 10th grade ELA teachers with higher value added have better test scores, are more likely to graduate on-time, and are more likely to attend and graduate from a four-year college than observably similar students assigned to 10th grade ELA teachers with lower value added. We also find that many of these relationships vary for students with and without disabilities, as 10th grade ELA teacher value added is more positively predictive of on-time graduation and four-year college attendance for students without disabilities, but more positively predictive of two-year college attendance and employment within two years of graduation for students with disabilities. In contrast to value added, other teacher characteristics like experience, degree level, endorsement area, and licensure test scores do not consistently predict better outcomes for students with or without disabilities.

1. Introduction

A growing literature that uses large-scale administrative datasets 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., Clotfelter et al., 2010; Goldhaber et al., 2013; Harris and Sass, 2011) and other influential research connecting teachers in elementary and middle schools to postsecondary outcomes like graduation and employment (e.g., 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).

Researchers have also only recently begun leveraging these databases to investigate the distribution and importance of teachers specifically for students with disabilities (e.g., Feng and Sass, 2010, 2012, 2013; Gilmour and Henry, 2018), despite the fact that nearly 6.5 million public school students with disabilities (approximately 13% of all students enrolled in public education) receive special education services as part of the Individuals with Disabilities Education Act (IDEA). As such, there is little empirical evidence about the extent to which students with disabilities are taught by lower-quality teachers, as measured by value added or teacher qualifications, and whether the relationships between these teacher characteristics and later outcomes differ for students with and without disabilities.

We help to fill these gaps in the literature by using 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 is possible because of a unique system of Washington state datasets that include detailed information about students' K-12 teachers and tracks students through the state's K-12 system and into the state's two-year colleges, four-year colleges, and workplaces. We use this dataset to investigate three broad research questions that directly address the gaps in the literature discussed above:

1. Are high school students with disabilities taught by lower-quality or less-qualified ELA teachers (as measured by value added, experience, degree level, subject-area endorsements, and licensure test scores) relative to their peers without disabilities?
2. Do ELA teacher characteristics predict the high school outcomes (absences, test scores, and high school graduation) and postsecondary outcomes (two-year and four-year college attendance/graduation and employment) of their students?
3. Do these relationships differ for students with and without disabilities?

We focus on students receiving ELA instruction 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 is motivated primarily by data availability during the study period. Specifically, there was a consistent high school ELA testing regime during our study period, which allows us to estimate value-added models of teacher effectiveness, while the high school math testing regime changed considerably during this time period.[1] Moreover, the data set does not include teachers who are funded through special education teaching positions, so we focus exclusively on regular education teachers in this analysis. Finally, we focus on teachers in classrooms in which less than half of students are receiving special education services because it allows us to estimate the associations between

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[1] Washington state transitioned in 2010-11 from the math High School Proficiency Exam (HSPE) that was taken by all 10th graders to end-of-course exams in Algebra and Geometry that are only taken by students enrolled in these courses. In contrast, the HSPE reading test was administered in 10th grade across all years of our study period. The history of Washington state assessments is available here: http://www.k12.wa.us/assessment/StateTesting/pubdocs/AssessmentTimeline.xlsx .

teacher characteristics and student outcomes in a general education setting that affects both students with and without disabilities.[2]

Among these students, we find little evidence that students with disabilities are taught by lower-quality or less-qualified teachers; specifically, while students with disabilities are slightly more likely to have a novice ELA teacher or an ELA teacher without an advanced degree in 11th and 12th grade, we find no significant differences in value added or licensure test scores between the ELA teachers of students with and without disabilities. This largely echoes findings in Gilmour & Henry (2018) that the distribution of teacher qualifications between students with disabilities and students without disabilities in late elementary and middle school math classrooms is relatively equitable in North Carolina Public Schools.

When we investigate the relationships between ELA teachers' qualifications and the longer-term outcomes of their students, we find that students assigned to 10th grade ELA teachers with higher value added have better test scores, are more likely to graduate on-time, and are more likely to attend and graduate from a four-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 find 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 assigned to

[2] We explore similar analysis for students with disabilities who receive instruction in classes in which more than half of students are receiving special education services. The estimated relationships between teacher qualifications and student long-term outcomes are qualitatively similar though underpowered due to small sample sizes in these classrooms, but there is more evidence that students with disabilities are taught by less-qualified teachers (e.g., with lower licensure test scores) when we include classrooms in which more than 50% of the students are receiving special education services.

novice teachers tend to have lower achievement, all else equal (e.g., Clotfelter et al., 2007; Rice, 2013; Rivkin et al., 2005; Rockoff, 2004).[3]

Finally, when we explore heterogeneity in these relationships for students with and without disabilities, we find considerable evidence that the relationships between ELA teacher value added and later outcomes vary for these two groups of students. Specifically, 10th grade ELA teacher value added is more positively predictive of on-time graduation and four-year college attendance for students without disabilities, but more positively predictive of two-year college attendance and employment within two years of graduation for students with disabilities. The differences in the relationships with college outcomes suggest that students with disabilities with more effective teachers may be more likely to attend a two-year college than not attend college at all, while students without disabilities with more effective teachers may be more likely to attend a four-year college than a two-year college. Finally, few of the other relationships vary for students with and without disabilities, and perhaps surprisingly given evidence from lower grade levels (Feng and Sass, 2013), we also find little evidence that students with disabilities disproportionately benefit from assignment to an ELA teacher with a special education endorsement.

The remainder of the paper proceeds as follows. Section 2 discusses the prior literature that motivates research questions 1–3, and Section 3 provides details about and summary statistics from the longitudinal dataset used in this study. We then describe the analytic models that address research questions #2 and #3 in Section 4, present and discuss the estimates from these models in Section 5, and offer concluding thoughts and directions for further research in Section 6.

[3] An important exception in this literature (because it echoes the findings from this paper) is Harris and Sass (2011), who do not find significant positive returns to teacher experience at the high school level.

2. Prior Literature

This study contributes to two separate literatures: one on the relationships between public school teacher characteristics and student outcomes; and another on interventions that can improve postsecondary outcomes for students with disabilities. Our focus on teachers in this paper is motivated by the literature demonstrating the importance of teacher quality in explaining students' K-12 success (e.g., Rivkin, Hanushek, & Kain, 2005) and postsecondary outcomes (e.g., Chamberlain, 2013; Chetty, Friedman, & Rockoff, 2014b). Most recently, Lee (2018) finds that cumulative exposure to more effective and qualified teachers between grades 7 and 12 is predictive of 12th-grade mathematics achievement and bachelor's degree completion. Our study builds on this prior work by considering the characteristics of *individual* teachers at the high school level and the relationships between these characteristics and a wide range of high school and postsecondary outcomes.

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., Clotfelter et al., 2005; Goldhaber et al., 2015, 2018; Isenberg et al., 2016; Kalogrides and Loeb, 2013; Lankford et al., 2002; Sass et al., 2010). 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, Friedman, & Rockoff, 2014a,b), but students also tend to score lower on standardized tests, all else equal, when they are taught by a novice teacher (e.g., Rice, 2013; Rivkin et al., 2005; Rockoff, 2004) or a teacher with lower licensure test scores (e.g., Clotfelter et al., 2006, 2007, 2010; Goldhaber, 2007; Goldhaber & Hansen, 2010; Goldhaber et al., 2017; Hendricks, 2014).

As discussed in the introduction, an emerging literature has extended some of these analyses to focus on students with disabilities. For example, a recent paper using data from North Carolina (Gilmour & Henry, 2018) investigates the distribution of teacher qualifications in upper elementary and middle school math classrooms between students with disabilities and students without disabilities. The authors find little evidence that students with disabilities are systematically assigned to less-qualified math teachers at these grade levels. Our investigation of research question #1 is intended to build on this prior work by addressing a similar question in high school ELA classrooms.

This study also builds on prior work from Florida (Feng & Sass, 2013) that investigates the relationship between various teacher qualifications and the test achievement of students with disabilities in grades 4-10. The authors find that students with disabilities tend to perform better on both math and reading tests when they receive instruction from a teacher who is certified in special education, and score higher in math when they receive instruction from a teacher with an advanced degree. The authors also report that these relationships often differ from the relationships for students without disabilities; for example, students without disabilities actually perform slightly worse when they are taught by a teacher certified in special education, all else equal. Our investigation of research questions #2 and #3 extends this prior work by considering a broader range of outcomes than just standardized test scores and focusing on higher grade levels.

This paper is most closely related to a pair of unpublished papers by the same authors (Feng & Sass, 2010, 2012) that consider teacher qualifications as predictors of high school and postsecondary outcomes of students with disabilities in Florida. Both papers report some significant relationships between teacher experience and degree level and student persistence and graduation from high school; for example, students with disabilities who are taught by a more experienced teacher are less likely to drop out of high school, all else equal. Feng & Sass (2010) also report that students with disabilities who are taught by a teacher certified in special education are less likely to find employment after graduation. This study builds on this prior work by considering both additional high school outcomes (absences and test performance) and additional measures of teacher qualifications (licensure test scores and value added).

The focus on postsecondary outcomes for students with disabilities in this paper and Feng and Sass (2010, 2012) is 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 like 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., Wagner 1992; Wagner, Newman, Cameto, Levine, & Garza, 2006; Newman, Wagner, Cameto, Knokey, & Shaver, 2010).

Our investigation of research question #3 is intended to contribute 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., 2015; Mazzotti et al., 2016; Test et al., 2009) that conclude 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, our prior work with the same dataset from Washington State described in this paper (Theobald et al., 2018) finds 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.

3. Data and Summary Statistics

3.1 Data Sources and Study Sample

The data for this project are 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 come 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 2009–10 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 are further linkable to the Washington Credential Database that contains information on teacher licensure test scores and teaching endorsements.

Although the CEDARS data system was introduced in the 2009–10 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 allow for baseline controls for student test achievement. Our primary measure of baseline performance comes 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 2009-10 and the Measures of Student Progress (MSP) test since 2009-10.[4] The 8th-grade WASL and MSP

[4] We include both the regular and basic versions of the WASL and MSP. The basic version of each test includes the same questions and is graded on the same scale as the regular version, but students with disabilities who take the basic version can pass with a lower score.

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.[5]

The datasets 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, four-year universities in Washington State and the State Board of Community and Technical Colleges (SBCTC) data system for public two-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.[6] The UI records are reported on a quarterly basis and run from 2010 through 2016 on the calendar year.

Because we have K-12 data between 2009–10 and 2012–13 linked to postsecondary data through 2015–16, we are able to consider the relationships between teacher qualifications and postsecondary outcomes for students from five different cohorts of students, summarized in **Table 1**. Within each cohort, we define the sample in subsequent grades as students who are still "on track" to graduate on time (e.g., 11th graders in each cohort consist only of students from the 10th-grade sample who proceeded to 11th grade the following year). After linking students to teachers via classroom identifiers, we further limit the dataset to ELA courses by using Washington State content area codes and course title names, and then limit the dataset to students who are receiving ELA instruction from a single regular education teacher in a classroom in which less than 50% of the students are receiving special education services.

[5] Due to a data error in the data provided by ERDC, assessment data in 2009 are missing for students from approximately 15% of districts.
[6] Note that 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 restrictions described above have different implications for students with and without disabilities. For example, the "on-track" restriction described above drops 14% of students without disabilities and 21% of students with disabilities by grade 12. Likewise, the restriction to classrooms in which less than 50% of the students are receiving special education services drops less than 2% of students without disabilities and about 15% of students with disabilities in each grade. As shown in Table 1, the final analytic sample in grades 10-12 after these restrictions includes 263,239 unique students and 13,108 students with disabilities, with Specific Learning Disability and Health Impairment as the most common disability types.

3.2 Teacher Characteristics

The student–teacher links in the CEDARS data set allow us to consider a number of different characteristics of the students' high school teachers. First, we estimate teacher value-added models for teachers in grade 10 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 use the following procedure for students linked to a 10th grade ELA test score. First, we create a residualized test score for each student *i* with teacher *j* in year *t* by estimating the following regression:

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

In the model in equation 1, the outcome variable Y_{ijt} is the ELA standardized test score for student *i* with teacher *j* in year *t*. The predictor variables include: $Y_{i(t-2)}$, a vector of 8th-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 use 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:

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

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

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

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

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

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

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

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 9th-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' 9th 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 (see 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 over 0.8. This helps justify our approach of using value-added estimates pooled across all students to predict outcomes for students with and without disabilities.[7]

The other measures of teacher quality and qualifications come directly from the various data sources discussed in Section 3.1. First, we utilize information on teacher credentialing areas and endorsements from the Washington State credentials database; of particular interest is whether each student is taught by a teacher with an endorsement to teach special education. Second, the credential database also contains licensure test scores on the state's Washington Educator Skills Test – Basic (WEST-B) exam in math, reading, and writing for every teacher who applied for a credential since 2002. We standardize all WEST-B scores across years and within subjects.[8] Finally, the S-275 data set contains the teaching experience and highest degree earned of each student's teacher. We construct indicators for whether each teacher has fewer than five years of experience ("novice teacher") and whether the teacher possesses a master's degree or higher ("advanced degree").

3.3 Student Outcome Measures

The K–12 data system also provides data on each of the three high school outcomes we consider in this study: the number of unexcused absences in each year; 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 10th-grade student in the sample took the High School Proficiency Exam (HSPE) test in reading at the end of the year, so we consider these test scores as a second high school outcome. We standardize each of these outcomes within grade and year to create continuous outcome measures for models described in Section 5. Our

[7] It is also unlikely in most applications that policymakers or researchers would have sufficient data to estimate value-added models solely for students with disabilities, which further motivates the use of overall value-added estimates in this analysis.

[8] WEST-B scores have been increasing in Washington State across years. See Goldhaber, Gratz, and Theobald (2017) for a discussion about standardizing teacher licensure tests within or across years.

final high school outcome is an indicator that the student graduated on-time with a regular high school diploma, which we create from the CEDARS student enrollment files.

Finally, we consider three measures of postsecondary success for each student in the sample: enrollment in a two-year college (from the SBCTC data described in Section 3.1); enrollment in a four-year college (from the PCHEES data described in Section 3.1); and employment in the state workforce (from the UI data described in Section 3.1). For earlier cohorts, we can also consider college graduation within four years of students' high school graduation date using completion files in the SBCTC and PCHEES datasets. For employment, we construct an indicator from the UI data for being employed more than half time for each quarter after a student's expected graduation. We then take 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.

3.4 Summary Statistics

We present and discuss two sets of summary statistics calculated from the analytic dataset described in Section 3. First, **Table 2** provides summary statistics for each of the outcome measures that will be considered in the analytic models described below in Section 4; these provide context for the magnitude of the relationships discussed below in Section 5. 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 Washington State. Importantly, as described in the previous section, 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 non-SPED and SPED students. Students with disabilities miss more days of school

(0.9-1.1 more days per years depending on the grade), score substantially lower on the High School Proficiency Exam in reading in 10th grade (by about 85 percent of a standard deviation), and are less likely to graduate on time (by about 12 percentage points) than students without disabilities.[9]

Panels D-F of Table 2 illustrate that, even conditional on on-time high school graduation, students with disabilities have lower rates of four-year college attendance, graduation, and employment after graduation than students without disabilities in the sample. For example, students without disabilities who graduate on-time are almost four times as likely to attend a four-year college the following year than students with disabilities who graduate on-time (24% vs. 7%) and over five times as likely to graduate from a four-year college within four years of their high school graduation (11% vs. 2%). Interestingly, students without disabilities are slightly less likely to attend a two-year college within two years of high school graduation (38% vs 40%), though this gap reverses when we consider completion from a two-year college. Finally, Panel G of Table 2 illustrates that students without disabilities who graduate on-time are about 9 percentage points more likely to be employed within two 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 in Section 3. Panel A illustrates some important demographic differences between students with disabilities and students without disabilities in the sample. Specifically, consistent with findings from other contexts (e.g., Coutinho & Oswald, 2005; Skiba et al., 2005), students with disabilities are much less likely to be female, are more likely to be an underrepresented minority (American Indian, Black, or Hispanic), and are much more likely to be receiving free or reduced-priced lunch than students without disabilities. The large differences between the 8th grade test performance of students with disabilities and students without disabilities shown in

[9] This gap in graduation rates closes slightly when we consider the five-year graduation rate of 12th graders (96% vs. 91%).

Panel B (approximately a standard deviation in math, reading, and science) illustrate the stark difference in baseline academic performance between the two groups of students.

Comparisons between the last two columns of Panels C-E of Table 3 address research question #1; i.e., are high school students with disabilities in Washington State taught ELA by more or less qualified teachers than their peers without disabilities? We find some evidence that students with disabilities receive ELA instruction from less-qualified teachers. For example, students with disabilities are more likely to have a novice teacher in 11^{th} and 12^{th} grade (by about 2 percentage points in 11^{th} grade and 3 percentage points in 12^{th} grade), and are less likely to have a teacher with an advanced degree in 11^{th} and 12^{th} grade (by about 1-2 percentage points). For context, the gaps in exposure to novice teachers are comparable in magnitude to similar gaps between disadvantaged (e.g., minority or eligible for free or reduced priced meals) students and advantaged students in 10^{th} grade ELA classrooms in Washington reported in Goldhaber et al. (2015).

That said, we find practically no evidence that students with disabilities are assigned to teachers with lower value added or performance on the WEST-B Reading test. While this may be surprising given that students with disabilities are disproportionately students of color and recipients of free or reduced priced lunch (see Table 3) 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 10^{th} grade reading than in lower grade levels and subjects. Finally, only a small percentage of teachers in the sample hold special education endorsements, 2-4 percent depending on the grade, but students with disabilities are more likely to have a teacher with such an endorsement in each grade—and, in fact, are about 50% more likely in grades 11 and 12.

Overall, these results suggest that students with disabilities in Washington State perform worse than their peers without disabilities on virtually all measures, are also taught by slightly less qualified teachers in terms of experience and advanced degree status, but are not taught by less effective teachers in terms of value added and licensure test scores. 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.

4. Analytic Approach

Our analytic approach to investigating research questions #2 and #3 is to estimate a series of student-level models predicting the measures of high school and postsecondary student outcomes described in Section 3.3 as a function of the various teacher quality measures described in Section 3.2, 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., Bacher-Hicks et al., 2014; Chetty et al., 2014a; Jackson, 2014; Kane & Staiger, 2008; Kane et al., 2013; Koedel et al., 2015; Rothstein, 2010, 2014) and generally suggests that models that control for the prior performance of students and other observable student characteristics are sufficient to account for the non-random sorting of students to teachers. Given this evidence, we include controls for prior performance on 8th grade WASL tests and other observable student characteristics (e.g., demographics and free/reduced priced lunch eligibility) in all of our specifications.

Additionally, 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, is to include additional controls for the average characteristics of a student's classmates so that students are only compared to other students who are taking classes with observably-similar students.

In addition to the sources of bias described above, 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 grade to 12th grade. This attrition does not appear to be random (e.g., lower-performing students are more likely to leave the sample) and is due to either students dropping out of school, moving to a private school, or moving to a school outside the state. In many cases, we can distinguish between 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 in section 3—but the exit reason cannot be determined for many students who leave between school years. Another challenge is that high school students are typically assigned to different teachers in each grade and year, so it is difficult to specify a single model that considers the aggregated "qualifications" of a student's high school teachers.[10]

Our solution to each of these challenges is to define and estimate models separately by grade and for only for the subset of students who are still attending Washington State public schools in that grade. This separation means that our estimates in each grade can only be interpreted 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 teachers in 12th grade can only affect students who are still enrolled in school in 12th grade.[11]

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[10] In fact, non-random attrition in high school grades is one potential drawback of the cumulative approach used in Lee (2018).

[11] An alternative approach would be to include fixed effects for grade and subject. This specification will only address concerns about non-random selection if the selection process is identical for all students within a grade, which does not seem plausible given that academically challenged students appear to be more likely to attrit.

With these considerations in mind, we estimate 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 each grade *g*. We first consider predictors of student unexcused absences, one of the high school outcomes described in Section 3. For each student in our analytic sample in grade *g*, we observe the number of unexcused absences ABS_g. We model this outcome as a function of student control variables in grade *g*, $\mathbf{X_g}$ which also includes indicators for each category of disability in our sample, the average characteristics of the student's ELA classmates in grade *g*, $\overline{\boldsymbol{X}}_{\boldsymbol{g}}$, the observable characteristics of the student's ELA teacher in grade *g*, $\boldsymbol{T}_g$, and (in some specifications) an interaction between this teacher characteristic and an indicator for whether the student is receiving special education services in grade *g*, S_g:

$$ABS_g = \beta_0^g + \beta_1^{g^T}\boldsymbol{X_g} + \beta_2^{g^T}\overline{\boldsymbol{X}}_{\boldsymbol{g}} + \beta_3^{g^T}\boldsymbol{T_g} + \varepsilon^{\beta g} \quad \text{(5a)}$$

$$ABS_g = \beta_0^g + \beta_1^{g^T}\boldsymbol{X_g} + \beta_2^{g^T}\overline{\boldsymbol{X}}_{\boldsymbol{g}} + \beta_3^{g^T}\boldsymbol{T_g} + \beta_4^{g^T}\boldsymbol{T_g} * S_g + \varepsilon^{\beta g} \quad \text{(5b)}$$

The coefficients in the vector β_3^g 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^g can be interpreted as the differences in these relationship between students with disabilities and students without disabilities, and thus address research question #3; i.e., are these relationships different for students with disabilities than for their peers without disabilities?

We estimate similar models for each of the other high school and postsecondary outcomes described in Section 3. We next model each student's reading test score $TEST_{10}$, as a function of the same terms in equation 5, and estimate specifications that do and do not include the interaction term in parentheses:

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

Finally, we consider a series of binary outcome variables: on-time graduation, college enrollment and graduation, and employment. We model 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):

$$f\left(\Pr(O = 1)\right) = \delta_0^g + \delta_1^{g^T}\boldsymbol{X_g} + \delta_2^{g^T}\boldsymbol{\overline{X}_g} + \delta_3^{g^T}\boldsymbol{T_g}\left(+\delta_4^{g^T}\boldsymbol{T_g} * S_g\right) + \varepsilon^{\delta g} \quad (7)$$

In our primary specifications of the model in equation 7, we use the identity function for *f* and estimate these regressions as linear probability models.[12] Thus, the coefficients represent the expected change in the probability of each outcome associated with each control variable.

5. Results

Tables 4–12 present estimates from various specifications of the models described in Section 4. For a given table, each column presents results from a separate regression that is designed to address research questions #2 and #3 for a given grade level, set of predictors, and set of outcomes. Within each outcome, the first of these columns reports estimates from the specification *without* an interaction term for students with disabilities (and thus addresses research question #2), while the second reports estimates from the specification *with* an interaction term for students with disabilities (and thus addresses research question #3).

Table 4 reports the relationships between four ELA teacher characteristics in 10th grade (value added, novice, advanced degree, and special education (SPED) endorsement) and six outcomes discussed in Section 5. 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 four-year

[12] We also estimate these models as logistic regressions, and the results are qualitatively similar.

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 the increase in the probability of attending a four-year college associated with a one standard deviation increase in 10th grade ELA teacher value added (.68 percentage points) is similar to the comparable estimate for 4th-8th grade teachers reported in Chetty et al. (2014b) (.74 percentage points).[13]

10th grade ELA teacher value added is also negatively predictive of two-year college attendance for the average student. This is perhaps counter-intuitive, but when we estimate separate models that drop students who attend a four-year college, we do not find a significant association between 10th grade ELA teacher value added and two-year college enrollment. This suggests that students assigned to higher value-added teachers who are on the margin of attending a two-year or four-year college may be induced into enrolling in a four-year rather than a two-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 and four-year college enrollment 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 other hand, the positive interactions in the models predicting two-year college enrollment and employment 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 two-year college enrollment for students without disabilities but positively predictive of two-year college enrollment for students with disabilities is suggestive of differential "substitution effects" for students with disabilities; specifically, students with disabilities

[13] A one standard deviation of value added in our sample is about .05 standard deviations of student performance.

with more effective teachers may be more likely to attend a two-year college than not attend college at all, while (as discussed above) students without disabilities with more effective teachers may be more likely to attend a four-year college rather than a two-year college.

Other teacher characteristics are far less predictive of student outcomes relative to value added, but a number of other relationships in Table 4 are statistically significant, and not always in the expected directions. Specifically, students with novice 10^{th} grade ELA teachers tend to have more absences, all else equal, than students with non-novice 10^{th} grade ELA teachers, but are also more likely to graduate on-time and attend a four-year college. Students with a 10^{th} grade ELA teacher with an advanced degree are also more likely to attend a two-year college but less likely to attend a four-year college. Finally, we find little evidence that 10^{th} grade ELA teachers with a 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 Tables 5 and 6 by considering outcomes three and four years after students' expected graduation date, respectively, for cohorts 2 and 3. In Table 5, the coefficient for value added on four-year college enrollment increases (0.915 percentage points), and is significantly different from the previous coefficient at the 0.10 level. This result is consistent with the notion that assignment to teachers with high value added scores is predictive of higher four year college enrollment among students who choose not to enroll immediately following high school. Moreover, the results in Table 6 illustrate that 10^{th} grade ELA teacher value added is also highly predictive of the probability that students *graduate* from a four-year college. On the other hand, we find far less evidence of heterogeneity between students with and without disabilities in terms of the relationships between 10^{th}

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.

Because we can only observe value added for 10th grade teachers, the results for grade 11 and 12 only consider other ELA teacher characteristics. To facilitate comparisons with other grades, Table 7 reports relationships in 10th grade from models that do not control for value added. While most of the results are consistent with those presented previously in Table 4, there are several new relationships with 10th grade reading test scores. These models suggest that students who are assigned to ELA teachers with advanced degrees tend to have higher test performance in 10th grade, and ELA teacher SPED endorsements are associated with lower test performance. This is consistent with the notion that when value added estimates are excluded from the model, other teacher characteristics will absorb the unexplained variation in teacher effectiveness.[14] We also find that SPED endorsements are associated with lower probabilities of four-year college enrollment (though the interaction for students with disabilities is statistically significant and positive, which is the one example of students with disabilities potentially benefitting from assignment to teachers with a SPED endorsement).

Tables 8 and 9 investigate these same relationships in 11th and 12th grade, respectively. We generally find weaker relationships in these grade levels, though ELA novice teachers are still associated with higher four-year college enrollment rates in both grades, while ELA teachers with advanced degrees in 12th grade are associated with higher rates of two-year college attendance and employment. Finally, we continue to find some negative associations between ELA teachers with SPED endorsements and some longer-term outcomes for students on average, though these relationships do not appear to be worse for students with disabilities.

[14] That said, there is also a small change in sample size, as value added estimates are not available for all students in our sample.

Finally, Tables 10-12 present models that consider the last measure of teacher quality (WEST-B Reading licensure test scores) that is only observed for a subset of the ELA teachers in the sample. Considering the estimates across all the three grades, we do not find more significant relationships between licensure test scores and outcomes than we would expect by random chance (about 15% at an $\alpha = 0.10$ significance level), from which we conclude that there is little evidence that licensure test scores are predictive of outcomes for all students or differentially predictive of outcomes for students with disabilities.

6. Conclusions

The findings from this paper 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 and college attendance. This suggests that improving teacher quality could be an effective way to improve outcomes for both students with and without disabilities, though our results also suggest that this is likely to lead to different pathways for these students. In particular, our results suggest that assignment to effective teachers may be particularly important for students with disabilities in terms of two-year college attendance and postsecondary employment, but may not improve four-year college enrollment outcomes (as it does for students without disabilities).

These findings are also important 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. Theoretically, there are three ways that teacher qualifications could contribute to these gaps: inequity between students with disabilities and students without disabilities in the distribution of teacher qualifications that predict future student outcomes; differential impact of these qualifications for students with disabilities; or both.

The results presented in this paper provide little evidence to support the hypothesis that students with disabilities have less access to effective or qualified teachers. Specifically, while the distribution of the qualifications of high school ELA teachers sometimes favor students without disabilities, on average, there is limited evidence of differences between students with and without disabilities in terms of the teacher qualifications that are predictive of longer-term outcomes (e.g., value added). 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 four-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 two-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.

References

Bacher-Hicks, A., Kane, T. J., & Staiger, D. O. (2014). Validating Teacher Effect Estimates using Changes in Teacher Assignments in Los Angeles (No. 20657). Cambridge, MA: National Bureau of Economic Research.

Buzick, H. M. and Jones, N. D. (2015). Using test scores from students with disabilities in teacher evaluation. *Educational Measurement: Issues and Practice*, 34: 28–38.

Chamberlain, G. E. (2013). Predictive effects of teachers and schools on test scores, college attendance, and earnings. *Proceedings of the National Academy of Sciences*, 110(43), 17176-17182.

Chetty, R., Friedman, J. N., & Rockoff, J. E. (2014a). Measuring the impacts of teachers I: Evaluating bias in teacher value-added estimates. *American Economic Review*, 104(9), 2593–2632.

Chetty, R., Friedman, J. N., & Rockoff, J. E. (201b). Measuring the impacts of teachers II: Teacher value-added and student outcomes in adulthood. *American Economic Review*, 104(9), 2633–2679.

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2005). Who teaches whom? Race and the distribution of novice teachers. *Economics of Education review*, *24*(4), 377-392.

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2006). Teacher-student matching and the assessment of teacher effectiveness. *Journal of Human Resources*, 41(4), 778-820.

Clotfelter, C. T., Ladd, H. F., and Vigdor, J. L. (2007). Teacher credentials and student achievement: Longitudinal analysis with student fixed effects. *Economics of Education Review*, 26(6): 673-682.

Clotfelter, C. T., Ladd H. F., and Vigdor, J. L. (2010). Teacher Credentials and Student Achievement in High School a Cross-Subject Analysis with Student Fixed Effects. *Journal of Human Resources,* 45 (3):655-681.

Coutinho, M. J., & Oswald, D. P. (2005). State variation in gender disproportionality in special education: Findings and recommendations. Remedial and Special Education, 26(1), 7-15.

Feng, L., & Sass, T. R. (2010). *The determinants of educational attainment and employment for students with disabilities*. Retrieved from http://myweb.fsu.edu/tsass/Papers/IES%20Feng%20Sass%20Special%20Ed%20Attainment%20008.pdf

Feng, L., & Sass, T. R. (2012). *Competing risks analysis of dropout and educational attainment for students with disabilities*. Andrew Young School of Policy Studies Research Paper Series No. 12-09. Retrieved from https://pdfs.semanticscholar.org/88f4/c83d84684a254e2da7153d2633f86fbabf0e.pdf

Feng, L., & Sass, T. R. (2013). What makes special-education teachers special? Teacher training and achievement of students with disabilities. *Economics of Education Review, 36*, 122–134.

Gilmour, A. F., & Henry, G. T. (2018). A comparison of the teacher quality of late elementary school students to the teacher quality of their peers without disabilities. *The Elementary School Journal*, 118 (3), 426-451.

Goldhaber, D. (2007). Everyone's Doing It, but What Does Teacher Testing Tell Us About Teacher Effectiveness? *Journal of Human Resources* 42 (4): 765–94.

Goldhaber, D., & Hansen, M. (2010). Race, gender, and teacher testing: How informative a tool is teacher licensure testing? *American Educational Research Journal*, 47(1), 218–251.

Goldhaber, D., Lavery, L., & Theobald, R. (2015). Uneven playing field? Assessing the teacher quality gap between advantaged and disadvantaged students. *Educational Researcher*, *44*(5), 293–307.

Goldhaber, D. D., Goldschmidt, P., & Tseng, F. (2013). Teacher value-added at the high-school level: Different models, different answers? *Educational Evaluation and Policy Analysis*, 35(2), 220-236.

Goldhaber, D., Gratz, T., and Theobald, R. (2017). What's in a teacher test? Assessing the relationship between teacher licensure test scores and student secondary STEM achievement and course taking. *Economics of Education Review* 61, 112-129.

Goldhaber, D., Quince, V., & Theobald, R. (2018). Has it always been this way? Tracing the evolution of teacher quality gaps in U.S. public schools. *American Educational Research Journal*, 55(1), 171-201.

Haber, M.G., Mazzotti, V.L., Mustian, A.L., Rowe, D.A., Bartholomew, A.L., Test, D.W. and 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), pp. 123-162.

Harris, D. N., & Sass, T. R. (2011). Teacher training, teacher quality and student achievement. *Journal of Public Economics*, 95(7-8), 798-812.

Hendricks, M. D. (2014). Public Schools Are Hemorrhaging Talented Teachers. Can Higher Salaries Function as a Tourniquet? Association for Education Finance and Policy.

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

Isenberg, E., Max, J., Gleason, P., Johnson, M., Deutsch, J., & Hansen, M. (2016). Do low-income students have equal access to effective teachers? Evidence from 26 districts. NCEE 2017-4007. Institute of Education Sciences.

Jackson, C. K. (2014). Teacher quality at the high school level: The importance of accounting for tracks. *Journal of Labor Economics*, 32(4), 645–684.

Kalogrides, D., & Loeb, S. (2013). Different teachers, different peers: The magnitude of student sorting within schools. *Educational Researcher*, 42(6), 304-316.

Kane, T. J, and Staiger, D. O. (2008). Estimating Teacher Impacts on Student Achievement: An Experimental Evaluation. Technical report, National Bureau of Economic Research.

Kane, T. J., McCaffrey, D. F., Miller, T., & Staiger, D. O. (2013). Have We Identified Effective Teachers? Seattle, WA: Bill and Melinda Gates Foundation.

Koedel, C., Mihaly, K., and Rockoff, J. E. (2015). Value-Added Modeling: A Review. *Economics of Education Review*.

Lankford, H., Loeb, S., & Wyckoff, J. (2002). Teacher sorting and the plight of urban schools: A descriptive analysis. *Educational Evaluation and Policy Analysis*, 24(1), 37-62.

Lee, S. W. (2018). Pulling back the curtain: Revealing the cumulative importance of high-performing, highly qualified teachers on students' educational outcome. *Educational Evaluation and Policy Analysis,* 0162373718769379.

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.

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)* (NCSER 2010-3008). Washington, DC: National Center for Special Education Research.

Rice, J. K. (2013). Learning from experience: Evidence on the impact and distribution of teacher experience and the implications for teacher policy. *Education Finance and Policy, 8*(3), 332–348.

Rivkin, S. G., Hanushek, E. A. & Kain, J. F. (2005). Teachers, schools, and academic achievement. *Econometrica*, 73(2), 417-458.

Rockoff, J. (2004). The impact of individual teachers on student achievement: Evidence from panel data. *The American Economic Review*, 94(2), 247-252.

Rothstein, J. (2010). Teacher Quality in Educational Production: Tracking, Decay, and Student Achievement. *The Quarterly Journal of Economics*, 125(1), 175-214.

Rothstein, J. (2014). Revisiting the impacts of teachers. UC-Berkeley Working Paper.

Sass, T. R., Hannaway, J., Xu, Z., Figlio, D. N., & Feng, L. (2010). Value added of teachers in high-poverty schools and lower poverty schools. *Journal of Urban Economics*, 72(2), 104-122.

Skiba, R. J., Poloni-Staudinger, L., Simmons, A. B., Renae Feggins-Azziz, L., & Chung, C. G. (2005). Unproven links: Can poverty explain ethnic disproportionality in special education? *The Journal of Special Education*, 39(3), 130-144.

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.

Theobald, R., Goldhaber, D., Gratz, T., & Holden, K. (2018). Career and technical education, inclusion, and postsecondary outcomes for students with learning disabilities. *Journal of Learning Disabilities*.

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., Newman, L., Cameto, R., Levine, P. & Garza, N. (2006). *An overview of findings from wave 2 of the National Longitudinal Transition Study-2 (NLTS2)* (NCSER 2006-3004). Washington, DC: National Center for Special Education Research, Institute of Education Sciences, U.S. Department of Education.

Tables

Table 1. Sample sizes by cohort, grade, and disability type

	Cohort 1	Cohort 2		Cohort 3			Cohort 4			Cohort 5		Unique Students
	Grade 12 2009–10	Grade 11 2009–10	Grade 12 2010–11	Grade 10 2009–10	Grade 11 2010–11	Grade 12 2011–12	Grade 10 2010–11	Grade 11 2011–12	Grade 12 2012–13	Grade 10 2011-12	Grade 11 2012-13	
No disability reported (non-SPED)	27,534	38,786	27,456	48,383	37,163	28,056	50,181	38,698	29,237	49,421	39,269	250,131
Specific learning disability	540	883	605	1150	989	703	1131	992	734	1200	1046	6834
Health impairment	278	487	312	588	509	322	679	583	404	663	615	3638
Communication disorders	30	53	112	113	168	143	186	158	98	223	156	797
Autism	55	81	63	120	104	71	155	127	96	151	148	745
Emotional/behavioral disability	27	88	49	81	73	51	135	88	47	135	100	622
Other disability	41	55	48	69	64	55	68	55	45	94	69	472
Total	28,505	40,433	28,645	50,504	39,070	29,401	52,535	40,701	30,661	51,887	41,403	263,239
Total With Disabilities	971	1647	1189	2121	1907	1345	2354	2003	1424	2466	2134	13,108

Note. SPED = special education. Sample sizes limited to students receiving ELA instruction from a single teacher in a given year and in a class with less than 50% SPED students. “Other disability” category includes all disability categories (intellectual disability, hearing impairment, multiple disabilities, orthopedic impairment, traumatic brain injury, deafness, visual impairment, developmental delays and deaf-blindness) with fewer than 10 students in any year or grade. Disability type in “Unique students” column is from student’s first year in the analytic sample.

Table 2. Student outcome summary statistics

	All students	Non–SPED student	SPED student
Panel A: Student absences			
Average number unexcused absences in 10th grade	1.48	1.44	2.40***
	(5.13)	(5.02)	(7.09)
Average number unexcused absences in 11th grade	1.95	1.90	2.96***
	(5.99)	(5.89)	(7.86)
Average number unexcused absences in 12th grade	2.65	2.60	3.73***
	(7.23)	(7.13)	(9.01)
Panel B: Student test performance			
Average standardized 10th-grade reading test score	0.29	0.33	-0.52***
	(0.88)	(0.86)	(0.89)
Panel C: Student grade progression and graduation			
Proportion 10th graders progressing to 11th grade	0.95	0.95	0.94***
Proportion 11th graders progressing to 12th grade	0.96	0.96	0.93***
Proportion 12th graders graduating from HS on time	0.94	0.94	0.86***
Proportion 10th-grade cohort graduating from HS on time	0.87	0.87	0.75***
Five-year graduation rate for 12th graders	0.96	0.96	0.91***
Five-year graduation rate for 10th-grade cohort	0.88	0.89	0.79***
Panel D: College attendance within two years of expected high school graduation date			
Proportion on-time HS graduates in two-year college	0.38	0.38	0.40***
Proportion on-time HS graduates in four-year college	0.27	0.27	0.09***
Proportion of original cohort in two-year college	0.36	0.36	0.35
Proportion of original cohort in four-year college	0.23	0.24	0.07***
Panel E: College attendance within three years of expected high school graduation date			
Proportion on-time HS graduates in two-year college	0.28	0.28	0.28
Proportion of original cohort in two-year college	0.27	0.27	0.26*
Proportion on-time HS graduates in four-year college	0.20	0.20	0.06***
Proportion of original cohort in four-year college	0.17	0.18	0.05***
Panel F: Four-year college graduation four years after expected high school graduation date			
Proportion on-time HS graduates graduating from two-year college	0.16	0.16	0.11***
Proportion of original cohort graduating from two-year college	0.41	0.14	0.08***
Proportion on-time HS graduates graduating from four-year college	0.11	0.11	0.02***
Proportion of original cohort graduating from four-year college	0.09	0.10	0.01***
Panel G: Employment within two years of expected graduation date			
Proportion on-time HS graduates employed at least half time	0.30	0.30	0.21***
Proportion of original cohort employed at least half time	0.29	0.29	0.19***

Note. HS = high school; SPED = special education. P-values from two-sided t-test : +p<0.1, *p<0.05, **p<0.01, ***p<0.001. 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% SPED students.

Table 3. Student characteristics and teacher qualifications

	All Students	Non–SPED student	SPED student
Panel A: Demographics			
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 free or reduced-priced lunch	0.367	0.362	0.478***
Panel B: Baseline test scores			
Average standardized eighth-grade math score	0.223	0.270	-0.759***
	(0.916)	(0.891)	(0.896)
Average standardized eighth-grade reading score	0.216	0.258	-0.669***
	(0.862)	(0.836)	(0.921)
Average standardized eighth-grade science score	0.224	0.264	-0.602***
	(0.893)	(0.873)	(0.916)
Panel C: 10th Grade ELA Teacher			
Average value-added score	0.001	0.001	0.001
	(0.054)	(0.054)	(0.053)
Average teacher experience	12.998	13.008	12.713***
	(9.139)	(9.144)	(9.082)
Proportion novice teachers (less than 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***
Average Reading WEST-B score (standardized)	0.479	0.478	0.493
	(0.714)	(0.713)	(0.743)
Proportion teachers in bottom quartile Reading WEST-B	0.093	0.094	0.083
Panel D: 11th Grade ELA Teacher			
Average teacher experience	14.050	14.063	13.647***
	(9.245)	(9.243)	(9.236)
Proportion novice teachers (less than 5 years experience)	0.163	0.163	0.186***
Proportion teachers with advanced degree	0.748	0.749	0.736*
Proportion teachers with SPED endorsement	0.023	0.022	0.035***
Average Reading WEST-B score (standardized)	0.447	0.446	0.477
	(0.751)	(0.751)	(0.783)
Proportion teachers in bottom quartile Reading WEST-B	0.106	0.107	0.098
Panel E: 12th Grade ELA Teacher			
Average teacher experience	15.131	15.178	14.171***
	(9.426)	(9.424)	(9.404)
Proportion novice teachers (less than 5 years experience)	0.151	0.149	0.183***
Proportion teachers with advanced degree	0.774	0.774	0.759*
Proportion teachers with SPED endorsement	0.032	0.032	0.044***
Average Reading WEST-B score (standardized)	0.478	0.477	0.501
	(0.761)	(0.754)	(0.882)
Proportion teachers in bottom quartile Reading WEST-B	0.116	0.116	0.105

Note. ELA = English Language Arts; SPED = special education. P-values from two-sided t-test : +p<0.1, *p<0.05, **p<0.01, ***p<0.001. 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% SPED students.

Table 4. Grade 10 ELA teacher characteristics and high school, transition, and postsecondary outcomes within two years of expected graduation (Cohorts 3-5)

Outcome:	Unexcused Absences		10th Grade Reading Test		On-time Graduation		Two-Year College Enrollment		Four-Year College Enrollment		Employment	
ELA Value Added	-0.097	-0.085	0.979***	0.976***	0.095***	0.106***	-0.060+	-0.073*	0.132***	0.136***	-0.004	-0.012
	(0.070)	(0.069)	(0.045)	(0.046)	(0.025)	(0.025)	(0.033)	(0.034)	(0.028)	(0.029)	(0.036)	(0.037)
ELA Value Added *		-0.320		0.050		-0.260*		0.325*		-0.098		0.210+
SPED Student		(0.295)		(0.188)		(0.130)		(0.137)		(0.076)		(0.120)
Novice Teacher	0.025*	0.027**	-0.006	-0.007	0.009**	0.010**	-0.000	0.001	0.018***	0.017***	0.004	0.005
	(0.010)	(0.010)	(0.006)	(0.006)	(0.003)	(0.003)	(0.004)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)
Novice Teacher *		-0.033		0.035		-0.014		-0.018		0.008		-0.007
SPED Student		(0.034)		(0.024)		(0.018)		(0.020)		(0.011)		(0.016)
Advanced Degree	-0.009	-0.010	-0.006	-0.006	0.004	0.004	0.009*	0.009*	-0.008*	-0.009*	-0.002	-0.003
	(0.009)	(0.009)	(0.005)	(0.005)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)
Advanced Degree *		0.021		-0.017		0.000		0.003		0.010		0.016
SPED Student		(0.031)		(0.022)		(0.016)		(0.017)		(0.009)		(0.014)
SPED Endorsement	0.041	0.020	-0.011	-0.008	0.001	0.003	-0.007	-0.007	-0.017+	-0.017+	-0.007	-0.006
	(0.026)	(0.022)	(0.014)	(0.014)	(0.008)	(0.008)	(0.011)	(0.012)	(0.009)	(0.009)	(0.012)	(0.012)
SPED Endorsement *		0.366*		-0.067		-0.027		0.009		0.008		-0.017
SPED Student		(0.143)		(0.057)		(0.034)		(0.042)		(0.017)		(0.033)
Number 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. SPED = special education. P-values from two-sided t-test : +p<0.1, *p<0.05, **p<0.01, ***p<0.001. Sample limited to students receiving English Language Arts instruction from a single teacher in a given year and in a class with less than 50% SPED students. 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 8th grade WASL scores, disability type, number of years diagnosed with a disability since 7th grade, and average classroom variables. Standard errors are clustered at the classroom level.

Table 5. Grade 10 ELA teacher characteristics and postsecondary outcomes within three years after graduation (cohorts 3 and 4)

Outcome:	**Two Year College Enrollment**		**Four Year College Enrollment**		**Employment**	
ELA Value Added	-0.106*	-0.119**	0.183***	0.187***	-0.033	-0.037
	(0.042)	(0.042)	(0.035)	(0.036)	(0.046)	(0.046)
ELA Value Added * SPED Student		0.333+		-0.082		0.116
		(0.173)		(0.099)		(0.170)
Novice Teacher	0.000	0.001	0.014**	0.014**	0.003	0.002
	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)
Novice Teacher * SPED Student		-0.026		-0.004		0.012
		(0.025)		(0.013)		(0.024)
Advanced Degree	0.006	0.007	-0.010*	-0.011*	-0.002	-0.003
	(0.005)	(0.005)	(0.004)	(0.004)	(0.006)	(0.006)
Advanced Degree * SPED Student		-0.020		0.003		0.017
		(0.022)		(0.012)		(0.020)
SPED Endorsement	-0.015	-0.016	-0.023*	-0.025*	-0.011	-0.012
	(0.013)	(0.014)	(0.011)	(0.011)	(0.014)	(0.015)
SPED Endorsement * SPED Student		0.009		0.027		0.011
		(0.050)		(0.025)		(0.052)
Number of students	66,948	66,948	66,948	66,948	66,948	66,948

Note. SPED = special education. P-values from two-sided t-test : +p<0.1, *p<0.05, **p<0.01, ***p<0.001. Sample limited to students receiving English Language Arts instruction from a single teacher in a given year and in a class with less than 50% SPED students. 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 8th grade WASL scores, disability type, number of years diagnosed with a disability since 7th grade, and average classroom variables. Standard errors are clustered at the classroom level.

Table 6. Grade 10 ELA teacher characteristics and postsecondary outcomes within four years of graduation (cohort 3)

Outcome:	**Two Year College Completion**		**Four Year College Completion**		**Employment**	
ELA Value Added	-0.010	-0.010	0.076*	0.078*	-0.043	-0.038
	(0.040)	(0.041)	(0.030)	(0.031)	(0.062)	(0.063)
ELA Value Added * SPED Student		-0.038		-0.045		-0.045
		(0.141)		(0.065)		(0.230)
Novice Teacher	0.005	0.005	0.010*	0.010*	0.009	0.009
	(0.005)	(0.005)	(0.004)	(0.004)	(0.008)	(0.008)
Novice Teacher * SPED Student		0.008		-0.013		-0.006
		(0.019)		(0.010)		(0.032)
Advanced Degree	-0.005	-0.004	-0.004	-0.004	0.010	0.007
	(0.005)	(0.005)	(0.004)	(0.004)	(0.008)	(0.008)
Advanced Degree * SPED Student		-0.020		-0.003		0.071*
		(0.018)		(0.009)		(0.028)
SPED Endorsement	-0.014	-0.017	0.010	0.010	-0.006	-0.007
	(0.012)	(0.012)	(0.009)	(0.010)	(0.019)	(0.020)
SPED Endorsement * SPED Student		0.040		0.008		0.018
		(0.041)		(0.025)		(0.066)
Number of students	34,249	34,249	34,249	34,249	34,249	34,249

Note. SPED = special education. P-values from two-sided t-test : +p<0.1, *p<0.05, **p<0.01, ***p<0.001. Sample limited to students receiving English Language Arts instruction from a single teacher in a given year and in a class with less than 50% SPED students. 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 8th grade WASL scores, disability type, number of years diagnosed with a disability since 7th grade, and average classroom variables. Standard errors are clustered at the classroom level.

Table 7. Grade 10 ELA non-value-added teacher characteristics and high school, transition, and postsecondary outcomes within two years of expected graduation (Cohorts 3-5)

Outcome:	**Unexcused Absences**		**10th Grade Reading Test**		**On-time Graduation**		**Two-Year College Enrollment**		**Four-Year College Enrollment**		**Employment**	
Novice Teacher	0.022**	0.025**	-0.006	-0.007	0.006*	0.007*	0.003	0.004	0.014***	0.014***	0.005	0.006
	(0.008)	(0.008)	(0.005)	(0.005)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
Novice Teacher * SPED Student		-0.048+		0.022		-0.016		-0.012		0.002		-0.011
		(0.028)		(0.020)		(0.015)		(0.016)		(0.009)		(0.013)
Advanced Degree	-0.009	-0.009	0.013**	0.014**	0.004	0.004	0.006	0.005	-0.005	-0.005	-0.002	-0.003
	(0.008)	(0.008)	(0.005)	(0.005)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
Advanced Degree * SPED Student		0.007		-0.012		-0.000		0.022		0.006		0.024+
		(0.028)		(0.019)		(0.014)		(0.015)		(0.008)		(0.012)
SPED Endorsement	0.044+	0.030	-0.026*	-0.024*	0.001	0.000	-0.004	-0.005	-0.022**	-0.024**	-0.012	-0.010
	(0.023)	(0.020)	(0.012)	(0.012)	(0.007)	(0.007)	(0.010)	(0.010)	(0.008)	(0.008)	(0.010)	(0.011)
SPED Endorsement * SPED Student		0.260*		-0.032		0.003		0.022		0.045*		-0.033
		(0.123)		(0.050)		(0.032)		(0.039)		(0.020)		(0.029)
Number of students	125,025	125,025	120,555	120,555	125,025	125,025	125,025	125,025	125,025	125,025	125,025	125,025

Note. SPED = special education. P-values from two-sided t-test : +p<0.1, *p<0.05, **p<0.01, ***p<0.001. Sample limited to students receiving English Language Arts instruction from a single teacher in a given year and in a class with less than 50% SPED students. 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 8th grade WASL scores, disability type, number of years diagnosed with a disability since 7th grade, and average classroom variables. Standard errors are clustered at the classroom level.

Table 8. Grade 11 ELA teacher characteristics and high school, transition, and postsecondary outcomes within two years of expected graduation (Cohorts 2-5)

Outcome:	**Unexcused Absences**		**On-time Graduation**		**Two-Year College Enrollment**		**Four-Year College Enrollment**		**Employment**	
Novice Teacher	0.029**	0.028**	0.003	0.003	-0.013**	-0.013**	0.011**	0.012**	-0.007	-0.007+
	(0.009)	(0.009)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Novice Teacher * SPED Student		0.019		0.002		-0.001		-0.000		0.014
		(0.032)		(0.013)		(0.018)		(0.010)		(0.014)
Advanced Degree	0.001	0.002	0.001	0.001	0.005	0.005	0.006+	0.006+	0.004	0.004
	(0.007)	(0.007)	(0.002)	(0.002)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)
Advanced Degree * SPED Student		-0.024		0.005		0.006		0.006		-0.005
		(0.029)		(0.012)		(0.015)		(0.009)		(0.013)
SPED Endorsement	0.027	0.018	-0.011	-0.011	-0.013	-0.011	-0.014+	-0.016+	0.014	0.014
	(0.024)	(0.020)	(0.009)	(0.009)	(0.011)	(0.011)	(0.008)	(0.008)	(0.011)	(0.012)
SPED Endorsement * SPED Student		0.130		-0.001		-0.029		0.024		-0.007
		(0.118)		(0.029)		(0.035)		(0.019)		(0.035)
Number of students	133,530	133,530	133,545	133,545	133,545	133,545	133,545	133,545	133,545	133,545

Note. SPED = special education. P-values from two-sided t-test : +p<0.1, *p<0.05, **p<0.01, ***p<0.001. Sample limited to students receiving English Language Arts instruction from a single teacher in a given year and in a class with less than 50% SPED students. 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 8th grade WASL scores, disability type, number of years diagnosed with a disability since 7th grade, and average classroom variables. Standard errors are clustered at the classroom level.

Table 9. Grade 12 ELA teacher characteristics and high school, transition, and postsecondary outcomes within two years of expected graduation (Cohorts 1-4)

Outcome:	**Unexcused Absences**		**On-time Graduation**		**Two-Year College Enrollment**		**Four-Year College Enrollment**		**Employment**	
Novice Teacher	0.005 (0.013)	0.003 (0.014)	0.007** (0.003)	0.006* (0.003)	-0.007 (0.005)	-0.007 (0.005)	0.012** (0.005)	0.012** (0.005)	-0.008 (0.005)	-0.010+ (0.005)
Novice Teacher * SPED Student		0.044 (0.052)		0.015 (0.015)		0.003 (0.024)		-0.001 (0.013)		0.034+ (0.020)
Advanced Degree	-0.037** (0.012)	-0.039** (0.012)	0.003 (0.002)	0.004+ (0.002)	0.013** (0.004)	0.014** (0.004)	-0.001 (0.004)	-0.001 (0.004)	0.013** (0.004)	0.014** (0.004)
Advanced Degree * SPED Student		0.029 (0.040)		-0.039** (0.013)		-0.008 (0.020)		-0.007 (0.010)		-0.026 (0.018)
SPED Endorsement	0.058* (0.027)	0.058* (0.027)	-0.000 (0.005)	-0.001 (0.005)	0.009 (0.010)	0.010 (0.010)	-0.026*** (0.008)	-0.027** (0.008)	0.007 (0.011)	0.007 (0.011)
SPED Endorsement * SPED Student		0.007 (0.091)		0.027 (0.026)		-0.019 (0.045)		0.014 (0.019)		0.007 (0.041)
Number of students	96,991	96,991	97,001	97,001	97,001	97,001	97,001	97,001	97,001	97,001

Note. SPED = special education. P-values from two-sided t-test : +p<0.1, *p<0.05, **p<0.01, ***p<0.001. Sample limited to students receiving English Language Arts instruction from a single teacher in a given year and in a class with less than 50% SPED students. 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 8th grade WASL scores, disability type, number of years diagnosed with a disability since 7th grade, and average classroom variables. Standard errors are clustered at the classroom level.

Table 10. Grade 10 ELA teacher licensure tests and high school, transition, and postsecondary outcomes within two years of expected graduation (Cohorts 3-5)

Outcome:	Unexcused Absences		10th Grade Reading Test		On-time Graduation		Two-Year College Enrollment		Four-Year College Enrollment		Employment	
WEST-B Reading	-0.029*	-0.025*	0.005	0.003	0.001	0.000	0.002	0.001	-0.004	-0.004	0.008	0.007
	(0.013)	(0.013)	(0.007)	(0.007)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)	(0.006)	(0.006)
WEST-B Reading * SPED Student		-0.091+		0.055*		0.005		0.023		-0.006		0.019
		(0.048)		(0.026)		(0.018)		(0.019)		(0.009)		(0.014)
Novice Teacher	0.003	0.012	-0.007	-0.008	-0.010+	-0.009	0.016*	0.015+	0.018*	0.018*	-0.012	-0.012
	(0.019)	(0.018)	(0.011)	(0.011)	(0.006)	(0.006)	(0.008)	(0.008)	(0.007)	(0.007)	(0.009)	(0.009)
Novice Teacher * SPED Student		-0.176*		0.020		-0.019		0.021		0.002		-0.011
		(0.086)		(0.047)		(0.030)		(0.034)		(0.017)		(0.028)
Advanced Degree	0.070***	0.070***	-0.013	-0.013	-0.009	-0.010	0.009	0.009	-0.006	-0.006	-0.022**	-0.022*
	(0.017)	(0.017)	(0.010)	(0.010)	(0.006)	(0.006)	(0.007)	(0.008)	(0.007)	(0.007)	(0.009)	(0.009)
Advanced Degree * SPED Student		0.005		0.014		0.006		0.020		0.006		-0.006
		(0.051)		(0.043)		(0.029)		(0.031)		(0.016)		(0.027)
SPED Endorsement	0.267*	0.196*	-0.061	-0.059	-0.033	-0.030	0.043	0.050+	-0.024	-0.033+	-0.022	-0.022
	(0.123)	(0.098)	(0.041)	(0.043)	(0.029)	(0.031)	(0.028)	(0.030)	(0.017)	(0.018)	(0.024)	(0.025)
SPED Endorsement * SPED Student		0.584		-0.012		-0.038		-0.052		0.088*		0.002
		(0.411)		(0.112)		(0.076)		(0.071)		(0.035)		(0.084)
Number of students	26,494	26,494	25,594	25,594	26,494	26,494	26,494	26,494	26,494	26,494	26,494	26,494

Note. SPED = special education. P-values from two-sided t-test : +p<0.1, *p<0.05, **p<0.01, ***p<0.001. Sample limited to students receiving English Language Arts instruction from a single teacher in a given year and in a class with less than 50% SPED students. 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 8th grade WASL scores, disability type, number of years diagnosed with a disability since 7th grade, and average classroom variables. Standard errors are clustered at the classroom level.

Table 11. Grade 11 ELA teacher licensure tests and high school, transition, and postsecondary outcomes within two years of expected graduation (Cohorts 2-5)

Outcome:	**Unexcused Absences**		**On-time Graduation**		**Two-Year College Enrollment**		**Four-Year College Enrollment**		**Employment**	
WEST-B Reading	-0.003	-0.003	0.002	0.003	0.007	0.006	0.002	0.003	-0.001	-0.001
	(0.009)	(0.010)	(0.003)	(0.003)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)
WEST-B Reading *		-0.002		-0.018		0.019		-0.003		0.010
SPED Student		(0.028)		(0.012)		(0.017)		(0.008)		(0.015)
Novice Teacher	0.031*	0.032*	0.000	0.000	-0.005	-0.004	0.017*	0.016*	-0.024**	-0.027***
	(0.014)	(0.013)	(0.004)	(0.004)	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)
Novice Teacher *		-0.008		-0.003		-0.022		0.020		0.053*
SPED Student		(0.063)		(0.024)		(0.033)		(0.017)		(0.025)
Advanced Degree	0.040**	0.044**	0.001	0.000	-0.008	-0.011	0.015*	0.015*	-0.020*	-0.022**
	(0.015)	(0.015)	(0.005)	(0.005)	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)
Advanced Degree *		-0.083		0.028		0.063+		0.003		0.048+
SPED Student		(0.057)		(0.025)		(0.034)		(0.016)		(0.027)
SPED Endorsement	0.388*	0.276*	-0.026	-0.016	-0.017	-0.016	0.039	0.030	-0.108***	-0.106***
	(0.171)	(0.130)	(0.035)	(0.035)	(0.032)	(0.033)	(0.029)	(0.029)	(0.025)	(0.025)
SPED Endorsement		1.187+		-0.110		-0.024		0.100		-0.016
* SPED Student		(0.717)		(0.087)		(0.102)		(0.072)		(0.069)
Number of students	25,261	25,261	25,267	25,267	25,267	25,267	25,267	25,267	25,267	25,267

Note. SPED = special education. P-values from two-sided t-test : +p<0.1, *p<0.05, **p<0.01, ***p<0.001. Sample limited to students receiving English Language Arts instruction from a single teacher in a given year and in a class with less than 50% SPED students. 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 8th grade WASL scores, disability type, number of years diagnosed with a disability since 7th grade, and average classroom variables. Standard errors are clustered at the classroom level.

Table 12. Grade 12 ELA teacher licensure tests and high school, transition, and postsecondary outcomes within two years of expected graduation (Cohorts 1-4)

Outcome:	**Unexcused Absences**		**On-time Graduation**		**Two-Year College Enrollment**		**Four-Year College Enrollment**		**Employment**	
WEST-B Reading	0.040*	0.045**	-0.003	-0.001	0.005	0.005	0.006	0.008	0.010	0.008
	(0.017)	(0.017)	(0.003)	(0.003)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.006)
WEST-B Reading *		-0.084		-0.023*		0.011		-0.022+		0.021
SPED Student		(0.053)		(0.011)		(0.022)		(0.012)		(0.018)
Novice Teacher	0.016	0.012	-0.000	-0.002	0.003	-0.000	0.012	0.011	-0.004	-0.007
	(0.026)	(0.026)	(0.005)	(0.005)	(0.009)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)
Novice Teacher *		0.107		0.036		0.068+		0.011		0.063+
SPED Student		(0.090)		(0.026)		(0.039)		(0.023)		(0.036)
Advanced Degree	0.003	-0.001	0.010+	0.011*	0.009	0.010	0.008	0.009	0.001	0.002
	(0.024)	(0.024)	(0.006)	(0.006)	(0.010)	(0.011)	(0.008)	(0.009)	(0.010)	(0.011)
Advanced Degree *		0.136		-0.044		-0.035		-0.026		-0.017
SPED Student		(0.110)		(0.032)		(0.046)		(0.021)		(0.044)
SPED Endorsement	0.345***	0.337***	-0.024	-0.030+	0.036	0.024	-0.021	-0.020	-0.039	-0.042
	(0.098)	(0.090)	(0.017)	(0.017)	(0.028)	(0.029)	(0.020)	(0.021)	(0.026)	(0.027)
SPED Endorsement		0.210		0.122*		0.240*		-0.021		0.060
* SPED Student		(0.560)		(0.054)		(0.100)		(0.046)		(0.112)
Number of students	16,086	16,086	16,091	16,091	16,091	16,091	16,091	16,091	16,091	16,091

Note. SPED = special education. P-values from two-sided t-test : +p<0.1, *p<0.05, **p<0.01, ***p<0.001. Sample limited to students receiving English Language Arts instruction from a single teacher in a given year and in a class with less than 50% SPED students. 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 8th grade WASL scores, disability type, number of years diagnosed with a disability since 7th grade, and average classroom variables. Standard errors are clustered at the classroom level.