National Board Certification as a Signal of Cooperating Teacher Quality

Dan Goldhaber
John Krieg
Roddy Theobald
Grace Falken

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National Board Certification as a Signal of Cooperating Teacher Quality

Dan Goldhaber
American Institutes for Research / CALDER
University of Washington

John Krieg
Western Washington University

Roddy Theobald
American Institutes for Research / CALDER

Grace Falken
University of Washington

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Abstract

Prior research has connected characteristics of cooperating teachers who supervise student teaching to performance measures of the teacher candidates they host, suggesting more effective teachers may also be better mentors. The specific measures of cooperating teacher effectiveness considered in this prior literature (value added and performance evaluations), however, are infrequently observable to individuals responsible for student teaching placements. In this paper, we consider a more easily observed proxy for mentor effectiveness: National Board (NB) Certification. We find that NB teachers are considerably more likely to host candidates than other teachers, candidates supervised by NB teachers are slightly more likely to be hired within three years, and these candidates have slightly lower value added in English language arts than their peers, all else being equal. We find no significant relationship between cooperating teacher NB certification and candidates' later attrition and value added in math. We conclude that individuals and policies seeking to leverage student teaching placements to improve student and teacher outcomes may need to focus on less easily observable proxies of cooperating teacher quality than NB certification status.

1. Introduction

Teachers certified by the National Board (henceforth, NB teachers) have long been touted as a resource for school improvement, including through the mentorship of new and prospective teachers (Darling-Hammond, 2010; Farrell, 2005). There are good theoretical and empirical arguments for leveraging National Board-Certified cooperating teachers (henceforth, NBCTs) for teacher candidates as they complete their student teaching.[1] The National Board for Professional Teaching Standards (NBPTS) argues that the National Board Certification process emphasizes teacher commitment to student learning, community, subject matter expertise, and continual self-improvement.[2] Matching teacher candidates with NBCTs introduces the opportunity for candidates to integrate some of these characteristics in their own teaching practice.

The number of teachers certified by NBPTS has grown by roughly 100,000 over the last two decades.[3] The 120,000 NB teachers in 2020-21 (NBPTS, 2022) represent about 5% of the public school teacher workforce nationwide. There is no national information about how many of these NB teachers serve as cooperating teachers for candidates completing student teaching, but states and districts sometimes note the perceived benefits of NBCTs. For example, the Kentucky Department of Education notes that "teachers who successfully meet National Board Certification requirements strengthen the teaching profession by mentoring new teachers, serving as role models and master teachers for teacher candidates, and assisting other teachers who seek National Board Certification" (Waddle, 2023).

[1] In the setting for this study, "cooperating teacher" refers to the teacher formally assigned to oversee a teacher candidate's preservice student teaching experience. In other contexts, cooperating teachers may be referred to as mentor teachers.
[2] For more on the vision, goals, and requirements of the National Board for Professional Teaching Standards, see: https://www.nbpts.org/certification/five-core-propostions/.
[3] Goldhaber et al. (2004) report that the number of NB teachers grew from less than 100 in 1995 to over 32,000 by 2003.

Empirically, a growing body of quantitative evidence shows that candidates who enter public schools tend to be more effective (based on district evaluations or value added measures) when a more effective cooperating teacher oversaw their student teaching (Bastian et al., 2020; Goldhaber et al., 2020; Goldhaber, Ronfeldt, et al., 2022; Ronfeldt et al., 2020). There is also some evidence that having an NBCT predicts better *preservice* practices of candidates (Bastian et al., 2022). The few studies that examine whether having an NBCT predicts the *in-service* effectiveness of candidates (e.g., Ronfeldt et al., 2021) are, however, based on relatively small samples.

Qualitative evidence documents how teacher candidate learning operates through the observation of their cooperating teacher and through direct coaching or mentoring (Grossman et al., 2012). The structure of the National Board Certification suggests that NB teachers may offer an easily identifiable way to tap into both mechanisms. NB teachers, relative to their peers, are 0.01 to 0.05 standard deviations (SDs) of student achievement more effective (Cowan & Goldhaber, 2016; Goldhaber & Anthony, 2007; Harris & Sass, 2009); illustrating best teaching practices may translate into candidates future effectiveness. Additionally, the self-reflective components of the National Board Certification process, which involve analysis of personal teaching practices, may improve teachers' abilities to provide constructive, specific feedback to candidates.

In this paper, we add to the literature on the relationship between cooperating teacher characteristics and the outcomes of teacher candidates who become public school teachers. We use data from Washington state to characterize the likelihood that NB teachers serve as cooperating teachers and link NBCTs to the future employment (public school entry and retention) and value added effectiveness of the candidates they mentor. To our knowledge, there

is no existing large-scale evidence on these relationships. Specifically, we use information about candidates linked to cooperating teachers from a sample of teacher education programs (TEPs) to investigate five research questions:

1. Are NB teachers more likely to serve as cooperating teachers than their peers?
2. What factors predict whether candidates complete student teaching with an NBCT?
3. Are candidates supervised by NBCTs more likely to enter the public school teacher workforce?
4. Are candidates supervised by NBCTs more likely to stay in the public school teacher workforce?
5. Are candidates supervised by NBCTs more effective teachers?

We find NB teachers are 1.9 percentage points more likely to host a candidate than their peers, all else being equal, which translates to NB teachers being about 59% more likely to serve as cooperating teachers. Candidates with science, technology, or math (STEM) endorsements and with higher basic-skills licensure test scores are more likely to complete their student teaching with an NBCT, while candidates with a special education endorsement are less likely, all else being equal.

Relative to peers whose cooperating teachers were not NB teachers, candidates supervised by NBCTs are not statistically more likely to be hired within one year of student teaching but are significantly more likely (by about 2 percentage points) to be hired within three years of student teaching. We observe little differential in teacher attrition based on supervision by an NBCT, and consistent with prior research (Bastian et al., 2020; Ronfeldt et al., 2021), we find little evidence of a positive relationship between cooperating teacher NB status and future candidate effectiveness. Specifically, we do not find significant differences in math teacher value

added associated with NBCTs, and we find that candidates supervised by NBCTs are slightly less effective than their peers in ELA (by less than 0.02 SDs of student performance).

2. Background: The Importance of Student Teaching and NBCTs

A growing body of quantitative research investigates the aspects of teacher preparation that influence employment outcomes and teacher performance. Much of this recent research has focused on candidates' student teaching experiences. Student teaching often provides candidates with their first teaching experiences before entering the workforce and is widely recognized as the most important component of an effective teacher preparation program (National Research Council, 2010). Although early quantitative research on student teaching focused primarily on the *school* and *district* in which student teaching occurs (Boyd et al., 2009; Goldhaber et al., 2017; Ronfeldt, 2012, 2015), there is an increasing focus on the cooperating teachers who supervise candidates' student teaching assignments.

The few studies that connect cooperating teachers to the employment outcomes of the candidates they mentor find little evidence that the characteristics of cooperating teachers predict the likelihood of candidates workforce entry or early-career attrition (Goldhaber et al., 2014, 2020). There is an emerging research base, however, showing that early-career teachers tend to perform better (i.e., have higher value added) if they worked with higher performing cooperating teachers during their student teaching. For instance, among candidates who enter the public teaching workforce in Washington state, a one SD increase in cooperating teacher value added is associated with 18% of an SD higher early-career value added in math and 11% of an SD higher value added in ELA (Goldhaber et al., 2020).[4] Similar research from Tennessee finds a slightly more modest relationship: a one SD increase in cooperating teacher value added is associated

[4] This association in math translates to the difference in efficacy between a novice teacher and a teacher with one to two years of experience (Goldhaber et al., 2020).

with a 6% of an SD increase in early-career value added, and also finds significant associations between the observational performance ratings of cooperating teachers and the early-career observational ratings of candidates who eventually become teachers (Ronfeldt et al., 2018).[5]

Across alternative measures of cooperating teacher competencies and qualifications, the associations with candidates' early-career performance are less consistent. Cooperating teachers' years of experience has been found to significantly predict candidates' early-career value added in North Carolina (Bastian et al., 2020) but not in other settings (e.g., Goldhaber et al., 2020; Ronfeldt et al., 2021). Higher cooperating teacher scores on licensure exams, prior year leadership ratings, and prior year ratings on facilitating learning also have no significant association with candidates' early-career value added (Bastian et al., 2020).

Recent experimental evidence has offered some potential mechanisms for these relationships, suggesting that effective cooperating teachers improve candidates' feelings of preparedness (Ronfeldt et al., 2020) and their instructional skills (Goldhaber, Ronfeldt, et al., 2022). However, it remains unclear how TEPs responsible for placing candidates into student teaching assignments can directly leverage these results. Perhaps most problematically, the cooperating teacher characteristics that predict better future outcomes for candidates (e.g., evaluation ratings or value added estimates) are not generally accessible to TEPs. This motivates the focus of the current study on NBCTs, which is more easily observable to training programs and districts responsible for placements.

A few studies on cooperating teachers have included information on their NB teacher status and the findings are mixed across outcomes. In one study, working with an NBCT is

[5] While Goldhaber et al. (2020) use prior-year cooperating teacher value added as their independent variable, Ronfeldt et al. (2018) use current-year cooperating teacher value added. Ronfeldt et al. (2018) report that using prior-year cooperating teacher value added halves the magnitude of their estimates, which are no longer statistically significant.

associated with *higher* value added for candidates in the top GPA quartile by 12% of an SD, and 11% of an SD *lower* value added for candidates in the bottom GPA quartile (Bastian et al., 2020). Across all GPA quartiles, Bastian and others (2020) find no significant relationship with early-career observation scores. A more recent study using a smaller sample in the same state, found that NBCTs are associated with 7% of an SD higher candidate performance on the edTPA, a preservice, portfolio-based teaching assessment (Bastian et al., 2022). Prior work in Chicago found that NBCTs have small negative effects on candidates' self-perceived preparedness, cooperating teacher-perceived preparedness, and first-year observation ratings (Ronfeldt et al., 2021). Research in San Francisco found positive but insignificant and imprecise associations between having an NBCT and classroom observation scores (Zhu et al., 2019).

One weakness of past studies relating NBCTs to candidate outcomes is the small sample size of NBCTs. For instance, Bastian et al. (2022) and Ronfeldt et al. (2021) observe approximately 530 and 280 NBCTs, respectively. Even Bastian et al. (2020), which observes the largest sample of NBCTs, cannot rule out effects smaller than 6.3% of an SD for value added and 4.5% of an SD for observational scores. Our subsample of over 2,700 candidates assigned to over 1,800 NBCTs translates to at least double the precision seen in existing evidence.

3. Data and Setting

Washington state is an excellent setting for studying the role of NBCTs. Washington has relatively large incentives for teachers to achieve National Board Certification and has, in recent years, been one of the states with the most new NB teachers in the country (NBPTS, 2013, 2014, 2015, 2016, 2018a, 2018b). We combine data from three different sources to paint a comprehensive picture of the relationship between NBCTs and future candidate outcomes: (a) data on over 20,000 teacher candidates and their student teaching placements provided by 15 in-state TEPs; (b) longitudinal data on all teachers and students in Washington public schools

provided by the Washington State Office of the Superintendent of Public Instruction (OSPI); and (c) comprehensive data on all NB teachers in the state since 1999, provided by NBPTS. We discuss each of these data sources in the subsections that follow and conclude this section by providing some summary statistics for our sample.

3a. Teacher Candidate Data

The foundation of our analytic data set is information on candidates and their cooperating teachers provided by 15 TEPs in Washington. We observe student teaching assignments for 20,478 candidates and 13,414 unique cooperating teachers (1,819 of which are NB teachers) from these 15 programs between the 2001-02 and 2018-19 school years. Our variable of interest for this study, whether each candidate has an NBCT, is the time-varying indicator for the cooperating teacher holding an active certification (see Section 3c).

A notable feature of our candidate data is that it is dominated by TEPs located west of the Cascade Mountains, a geological barrier in Washington. These TEPs prepare over 90% of all new teachers west of the Cascades who graduated from in-state TEPs, but only about 60% in the eastern half of the state (Krieg et al., 2020b). Because there are considerable economic and demographic differences between the west and east sides of the state, we caution against generalizing our findings. Where necessary, we present findings west of the Cascades because that sample has fewer omissions. A final feature of the data environment is that Washington state requires cooperating teachers to have a minimum of three years of teaching experience. While generally followed, our data suggests that a small number of candidates (2.32%) in Washington train with cooperating teachers who have less than three years of experience.

3b. OSPI Data

We connect the candidate data described above to longitudinal data on students and teachers provided by Washington State's OSPI. These data include student-level demographics and math and reading test scores for grades 3-8. From 2006-07 through 2008-09, we link students in grades 3-5 to their classroom teacher by their proctor on the state exam.[6] From 2009-10 through the most recent year of available data, 2018-19, the state's CEDARS data system links students to their classroom teachers through unique course identifiers.[7] Our value added measures and corresponding models are thus constrained to math and reading teachers in these grades and years.

For cooperating teachers and candidates hired into a Washington public school, OSPI data include information on teacher background, credentials, and individual characteristics for the entire study period. We observe individual years of teaching experience, highest academic degree earned, areas of teaching endorsement, performance on endorsement assessments and number of attempts, performance on and number of attempts taking the Washington Educator Skills Test - Basic (WEST-B)[8] for math, reading, and writing, and individual demographics.

In some of the analyses below, we use additional information about the schools in which student teaching takes place, as well as the schools that candidates are hired into. Specifically, we compute the percentage of a school's students who are underrepresented minorities (URMs), code the location of schools (relative to the Cascades as well as area urbanicity) and calculate the

[6] The proctor of the state assessment was used as the teacher–student link for at least some of the data used for analysis. The *proctor* variable was not intended to be a link between students and their classroom teachers, so this link may not accurately identify those classroom teachers.

[7] CEDARS data include fields designed to link students to their individual teachers, based on reported schedules. However, limitations of reporting standards and practices across the state may result in ambiguities or inaccuracies around these links.

[8] Because Washington accepts several alternative assessments to qualify for teacher certification other than the WEST-B and only began administering this assessment in 2002, we only observe WEST-B scores for 16,697 (or 81.5% of) candidates in the sample.

number of classified as well as certificated staff per 100 students.[9] In addition, we make use of two school-level measures that have been shown to be connected with candidates' student teaching placement and hiring: (1) the number of certified teacher job openings in the year after student teaching (Goldhaber et al., 2020); and (2) the stay ratio, which measures the percentage of teachers who remain in the school over a five-year period (Goldhaber et al., 2017).

3c. NBPTS Data

The final data source comes from NBPTS, which provided data on all 11,603 NB teachers in Washington since 1999. Figure 1 shows the number of NB teachers in the state, the total number of K-12 public school teachers in the state, and the share of teachers who are NB teachers over time. As the figure shows, the number and share of NB teachers increased rapidly over two decades from less than 1% through 2004 to over 9% in every year since 2012. This increase has important implications for our analysis that we discuss in the next section.

Teacher records from NBPTS contain the date of a teacher's first application for National Board Certification, the date originally certified, the date of certificate expiration, and details of the certificate type and applicant name. For teachers who have renewed their certificate, the expiration date reflects that extended period of validity. We can link 92% of individuals in the NBPTS data to the OSPI administrative data on teacher characteristics (described above) by fuzzy matching on teacher name and school, followed by teacher name and district, and lastly by teacher name. We transform these data into a time-varying indicator for holding an active National Board certificate for all teachers in all years, where the indicator spans the calendar year when certification is first awarded through the calendar year when the certification expires or the end of the panel. Thus, the variable of interest in this paper, whether a candidate works with an

[9] The URM percentage includes students who are Black, Hispanic, and American Indian.

NBCT, is a time-varying indicator for whether a candidate's cooperating teacher has an active certificate in the year of student teaching.

3d. Analytic Datasets and Summary Statistics

Table 1 provides summary statistics for all teachers in Washington who are eligible to host a teacher candidate (based on having three years of teaching experience) and who teach west of the Cascade Mountains (i.e., where our data likely have nearly comprehensive coverage of student teaching placements). Because some teachers supervise more than one candidate over multiple years, we present Table 1 in terms of teacher-years. As a result, the same individual may be in the cooperating teachers ("CTs") column when they supervised a student and in the "Non-CTs" column when they did not. For the purposes of the table, we focus solely on the 2009-10 through 2014-15 school years because these are the years with the most comprehensive student teaching data (Krieg et al., 2020).

In these six school years, we observe over 222,000 eligible cooperating teacher/year observations. Overall, these eligible cooperating teachers average over 15 years of experience, with the modal teacher being a woman who works in a suburban district and holds an elementary endorsement (column 1). The second and third columns of Table 1 present descriptive statistics for teachers during the year they supervised a candidate (column 2) and for years when they did not (column 3). Cooperating teachers differ from non-cooperating teachers in meaningful, observable ways (the asterisks in column 2 show statistical differences with column 3). Most relevant for our analysis, NB teachers are clearly more likely to serve as cooperating teachers: over 18% of cooperating teacher-years in these districts and years had a NBPTS credential (at the time of supervision) as compared to about 10% of non-cooperating teacher-years. Cooperating teachers in this sample are also *less* experienced on average (i.e., after accounting

for experience eligibility), are more likely to hold an advanced degree, and have higher credential test scores. Cooperating teachers also tend to teach in schools that have more URM students, are more urban, and are closer to the nearest TEP. The bottom rows of the table show that, among eligible cooperating teachers with value added estimates (described in the next section), cooperating teachers have significantly higher value added than those who do not supervise candidates.

Returning to the full sample of 20,478 candidates, Table 2 provides summary statistics disaggregated by whether the candidate worked with an NBCT during their student teaching in columns 1 and 2. Column 1 shows that candidates supervised by NBCTs are more likely to be endorsed in STEM or English-Language Learning (ELL) and less likely to be endorsed in special education and elementary education. Moreover, they score higher on all phases of the WEST-B licensure test and tend to have student teaching placements in schools with lower stay ratios and more URM students.

The rest of Table 2 focuses on the two primary subsamples for the remainder of the analysis: all candidates hired into the state's public teaching workforce (columns 3 and 4); and all candidates hired into subjects and grades in which we can estimate their value added to student test scores (columns 5 and 6). The comparisons between candidates hosted by NBCTs and other candidates largely hold in these samples, but we can also compare raw differences in outcomes. As shown near the bottom of columns 3 and 4, candidates hosted by an NBCT are less likely to leave the workforce at any point over the course of our study period. As we discuss later, this is partially because candidates in the earlier years of data were both less likely to match with an NBCT for their student teaching (see Figure 1) and attrition rates in these years were

generally lower. Finally, we see no significant differences in mean value added between candidates who are and are not hosted by an NBCT.

4. Methodology

Given that RQs 1 through 4 are all yes/no questions, we answer them by employing a series of logit models of the form:

$$\log\left(\frac{\Pr(y_i=1)}{\Pr(y_i=0)}\right) = \alpha_0 + \beta X_i + T_i + \varepsilon_{ik} \qquad (1)$$

where y_i is a binary outcome variable and X_i is a vector of explanatory variables that vary by research question. All logits include year fixed effects (T_i), and some specifications include fixed effects for various membership variables (e.g., TEPs, schools, and districts) that may be correlated with both the independent variables of interest and the outcome. For ease of interpretation, we present the results from each model as the marginal effects on the probability of y_i = 1 so our results are best thought of as the change in the probability of the given outcome associated with a unit change in the given predictor variable for the average teacher in the sample.

We first apply Equation (1) to the question (RQ1) of whether NB teachers are more likely to serve as cooperating teachers. Specifically, the sample consists of all teachers in Washington (or all teachers in a subsample), where teachers who supervised a candidate are assigned y_i = 1 and all other teachers are assigned y_i = 0. In this case, the vector X_i consists of all teacher characteristics listed in Table 1 including a binary indicator if the teacher is an NB teacher. The vector X_i also contains information about the teacher's school, including the number of job openings in the subsequent year, distance to nearest TEP, and basic school demographic information. In models that include school fixed effects, these additional regressors are necessarily omitted. Our school fixed effects models compare the probability of student-teaching

supervision among teachers within the school rather than within the state (without fixed effects). Because NB teacher status is time-varying, we can also estimate specifications that include teacher fixed effects to investigate whether teachers are more likely to mentor a candidate in years in which they have an active National Board Certificate than in years in which they do not.

To understand which candidates are more likely to be placed with an NBCT (RQ2), we make use of Equation (1) but consider the sample of all candidates in the data and redefine $y = 1$ as the case where an NBCT supervises the candidate and 0 otherwise. In this case, X_i represents the characteristics of the candidates outlined in Table 2. Because not all candidates take the WEST-B exam, we estimate two versions of Equation (1) where one version observes all student teachers but omits WEST-B scores while the other replaces missing scores with zeroes and includes an indicator for missingness. We also include TEP (institution) fixed effects to account for potential differences according to the education program attended; these fixed effects create comparisons of student teaching placements for candidates from the same TEP.

RQ3 asks whether candidates are employed in a Washington K-12 public school teaching job. We might expect strong mentors to improve candidates' hiring prospects through mechanisms such as hiring-specific advice, strong letters of recommendation, or networks that form between NB teachers. Here, too, we consider the sample of all candidates, but we define $y = 1$ if a candidate is employed as a teacher within one year of student teaching and as 0 otherwise. In alternative specifications, we define $y = 1$ when we observe a candidate in a K-12 teaching job within three years of student teaching. In either case, X_i contains information about the cooperating teacher including their NB teacher status, information on the school where student teaching took place, and the information about the candidate displayed in Table 2. These

models also include institution fixed effects to account for differences in job outcomes across TEP programs.

Next, we investigate the relationship between cooperating teacher characteristics and teacher retention (RQ4). We restrict the sample to candidates hired into a public K-12 teaching job. For these individuals, we consider each annual observation and define *y* as a binary indicator for whether a candidate leaves the teacher workforce at the end of that school year. We include all years of data for all hired teachers until the first year they leave the workforce; this is equivalent to discrete time hazard models used in prior work (e.g., Ronfeldt, 2012). In these models, X_i includes the information in Table 1 on the candidate's cooperating teacher, the candidate's information in Table 2, information about the student teaching context, and information on the school the candidate was hired into. This last group of variables includes the school's stay ratio, the percentage of URM students, binary variables indicating geographic areas (urban, township, rural), and if the student teaching took place in the school, district, or grade level the candidate was hired into ("Match school," "Match district," "Match school level"). These latter variables are important given prior evidence connecting them to later teacher retention (Goldhaber, Krieg, Theobald, & Goggins, 2022) and teacher effectiveness (Krieg et al., 2022), as well as the potential networking effects.

Our final research question (RQ5) relates supervision by an NBCT to the effectiveness of hired candidates, which we expect could transfer either through observed teaching practices or direct coaching. We estimate these models in two stages: first estimating the value added of all teachers in the state, then using these estimates as the dependent variable in a second-stage regression that includes an indicator for having been supervised by an NBCT. This allows our

first stage to leverage all statewide data to get precise estimates of the coefficients in the following value added model of student test score gains:

$$Test_{ijst} = Test_{i(t-1)}\gamma_1 + X_{ijt}\gamma_2 + \tau_{ist} + \epsilon_{ijst} \qquad (2)$$

In Equation (2), outcome $Test_{ijst}$ is the test score of student *j*, taught by teacher *i* in subject *s* (math or ELA) and year *t*. The lagged vector $Test_{i(t-1)}$ includes a cubic polynomial in lagged test scores in both math and ELA interacted with grade, while the control vector X_{ijt} includes student demographics, participation in programs (e.g., special education or English as a second language programs), and classroom aggregates of these variables. The teacher fixed effect for teacher *j* in subject *s* (math or ELA) and year *t,* τ_{ist}, can be interpreted as the average difference in test score gains between students in that teacher's class and year relative to the average class in the state.

We then use these annual teacher value added estimates $\hat{\tau}_{jst}$ as the outcome of a second-stage regression, as specified in the model in Equation (3):

$$\hat{\tau}_{ist} = \beta_0 + \beta C_i + \gamma T_{it} + \alpha S_{it} + \epsilon_{ist} \qquad (3)$$

In Equation (3), C_i represents the cooperating teacher and student teaching school characteristics of teacher *i* (including whether the cooperating teacher is an NBCT), T_{it} represents the teacher's own characteristics in year t, and S_{it} represents the characteristics of the teacher's school in year *t*. Because we anticipate any cooperating teacher effects to fade over time (Goldhaber et al., 2020), we estimate Equation (3) for all teachers but also just for teachers in their first two years of teaching. Of course, this sample is restricted to those who teach in value added grades and subjects in Washington. Because we observe value added measures for cooperating teachers, we also follow Goldhaber et al. (2020), modeling a specification where the cooperating teacher value added is included under the theory that more effective cooperating teachers may directly

contribute to the value added; in these models the relationship between NBCTs and value added is therefore the relationship *beyond* what we would expect based on the higher average effectiveness of NB teachers. Finally, to account for measurement error in the first-stage regressions from Equation (2), we weight all second-stage regressions proportionally to the inverse squared standard error of the value added estimates $\hat{\tau}_{ist}$, giving more weight to teachers with more precise estimates of value added.

The primary threats to interpreting the results of these models as causal are all related to various forms of non-random selection. For instance, one might imagine that teacher candidates who are more committed to working in public schools could seek out NB teachers to supervise student teaching and would also be more likely to be employed and less likely to leave teaching. If the control variables failed to fully account for this commitment, we might conflate the effect of having an NBCT with the educational commitment of the candidate. While we include rich control variables to account for potential selection bias, we characterize our results in descriptive terms in the next section and, where appropriate, speculate on the likely direction of any biases that might result from non-random sorting.

A final caveat to this analysis is that we are unable to rule out effects on early-career value added *if* we expect that the effect of working with an NBCT on candidates operates *only* through the elevated efficacy of NB teachers. Prior literature suggests that the relationship between cooperating teacher value added and first-year teacher math value added is about 0.2 (Goldhaber et al., 2020), and we find that NB teachers have about 0.04 SDs higher impact on student performance than their peers. Taken together, we would expect the association between working with an NBCT and early-career value added to be about 0.008 (0.2*0.04) SDs of student performance, which is a very small effect to detect even with these large sample sizes. Thus the

key question in this part of the analysis is whether there is a relationship between cooperating teacher NB status and early-career teacher effectiveness *beyond* what we would expect based on the higher effectiveness of NB teachers alone.

5. Results

5.1 Are NB teachers more likely to serve as cooperating teachers than their peers?

In Table 3 we report estimates from Equation (1), which investigates the likelihood of teachers hosting a teacher candidate in a given academic year. We focus on the first column of the table, which estimates this model for all eligible teachers (i.e., with at least three years of experience) who work west of the Cascade Mountains, where our coverage of student teaching placements is best. We find that NB teachers are 1.9 percentage points more likely to supervise a candidate than non-NB teachers. In this sample, 7,204 out of 222,251 teacher-years were spent supervising candidates at a rate of about 3.2%. Thus, NB teachers are about 59% (=1.9/3.2) more likely to supervise student teachers than non-NB teachers.

Before discussing the other estimates in Table 3, consider the other variables in column 1. Teachers with master's degrees, female teachers, and teachers who graduated from one of the TEPs participating in this study are more likely to supervise candidates. Though not reported in Table 3 due to space constraints, teachers employed in districts further from TEPs are less likely to supervise candidates, as are teachers in townships or rural areas. Teachers serving in urban districts are more likely to supervise student teaching than those in suburban areas. These findings suggest that proximity to TEPs is an important correlate of cooperating teacher service.

The remainder of Table 3 shows results for different levels of fixed effects and control variables. In column 2, we control for teacher value added (including missing dummies for teachers without value added estimates) and find that the relationship between NB teacher status and the probability of hosting a candidate barely changes. Likewise, when we include school

fixed effects in column 3, we still find that NB teachers are almost 2 percentage points more likely to host a student teacher than non-NB teachers in the same school. Finally, we include teacher fixed effects in column 4 and show that individual teachers are about 8 percentage points more likely to host a student teacher in years they have NB teacher status than in years they do not (note that this model is identified only by teachers who host a candidate during the sample period, which explains why this marginal effect is so large). Together, these models suggest a strong association between NB teacher status and individual likelihood of serving as a cooperating teacher. This association could imply either that TEPs and schools use NB teacher status as a signal of potential mentor quality in matching decisions or that NB teachers are more willing to mentor teacher candidates.

5.2 What factors predict whether candidates complete student teaching with an NBCT?

We address our second research question in Table 4, which reports marginal effects from logit models where the dependent variable equals 1 if a candidate was supervised by an NBCT. Here, the units of observation are all candidates. A quick glance at the coefficients in the first three columns of Table 4 suggests that very few candidate characteristics predict being supervised by an NBCT. Of the included regressors, only endorsement type is consistently statistically significant across all model specifications. STEM-endorsed candidates are almost 7 percentage points more likely to be supervised by an NBCT; in contrast, candidates endorsed in special education are about 3 percentage points *less* likely to be supervised by one. Given the overall 13.3% rate of NBCT supervision, these numbers suggest that endorsement type is a strong predictor of supervision.

In columns 4-6, we add candidate WEST-B scores as an additional predictor and find that candidates with higher WEST-B scores are significantly more likely to be supervised by an

NBCT. Interestingly, this coefficient is an order of magnitude smaller and no longer statistically significant when institution fixed effects are included in the final column. This suggests that most of this relationship is across TEPs (i.e., TEPs with higher-scoring candidates also tend to place more candidates with NBCTs) rather than within TEPs (i.e., higher-scoring candidates are no more likely to be supervised by an NBCT than other candidates at their TEP). This is important to keep in mind because if stronger candidates seek out NBCTs as mentors, we will associate any changes in outcomes in our later research questions with NBCT mentorship when it in fact reflects selection bias among candidates. This does not seem to be the case, however, when comparisons are made within TEPs.

5.3 Are candidates supervised by NBCTs more likely to enter the public school teacher workforce?

Table 5 provides estimates of the likelihood that student teachers are observed in Washington public schools within one year (columns 1–3) and three years (columns 4–6) of student teaching. As a point of reference for interpreting subsequent effect sizes, 49.2% of candidates we observe are hired within one year of student teaching and 68.7% are hired within three years. All models in Table 5 include TEP fixed effects so the comparison group is other candidates who attended the same TEP.

Focusing on the relationship between NBCT supervision and probability of workforce entry, we do not find a significant relationship in any sample or specification between student teaching with an NBCT and the probability of entering the workforce within one year. Across other estimates in columns 1-3, there are expectedly large differences in hiring rates by endorsement field with STEM-, SPED- and, to a lesser extent, ELL-endorsed candidates more

likely to be hired than elementary-endorsed teachers (Goldhaber et al., 2014). Female candidates and non-White candidates are more likely to be hired within one year as well.

Given that many candidates are not immediately observed in the workforce in the year after being certified to teach, but do show up eventually (Goldhaber, Krieg, Theobald, & Liddle, 2022), the second panel of Table 5 reports the coefficient estimates for analogous specifications that describe the likelihood of employment within *three* years of student teaching. Here we do find a positive, statistically significant relationship between student teaching with an NBCT and workforce entry; candidates supervised by an NBCT are about 1.8 percentage points more likely to enter the teaching workforce within three years than candidates supervised by non-NBCTs. This represents a 2.65% increase in the overall probability of working as a K-12 teacher.

5.4 Are candidates supervised by NBCTs more likely to stay in the public school teacher workforce?

We now turn to the relationship between student teaching under an NBCT and workforce attrition among hired candidates. One potential pathway for this association may be if stronger mentors provide more realistic expectations about the reality of teaching, better preparing candidates for the challenges of the job. In Table 6 we report the marginal effects from estimating Equation (1) in which $y = 1$ if a teacher leaves the workforce at the end of the school year and $y = 0$ otherwise. As we describe above, we first estimate these discrete-time hazard models across all observable years for each hired candidate (columns 1-3), and then limit the sample to the first two years in the workforce (columns 4-6). We re-estimate our models on this subsample because teacher attrition is highest in early-career years and teacher preparation effects tend to fade out the longer teachers are in the workforce. We estimate specifications that control for cooperating teacher and hired candidate value added (columns 2 and 5) and make

comparisons only between teachers in the same school (columns 3 and 6). For context, 7.2% of these teachers leave the workforce in a typical year, while 8.4% leave within their first two years of teaching.

Focusing primarily on the indicator that candidates had an NBCT in the first column of Table 6, we find no statistically significant evidence that candidates placed with NBCTs are any more or less likely to leave the teacher workforce than candidates placed with non-NBCTs. The standard errors on these estimates are about a quarter of a percentage point and, given that all point estimates are less than 0.1 percentage points, we can rule out effects of more than about 0.6 percentage points in either direction. The same holds for candidates' early-career years, with no statistically significant relationship between having an NBCT and attrition. The precision of these estimates rules out effects more than about 1.5 percentage points in either direction.

Given that the summary statistics in Table 2 show a significant raw difference in attrition between candidates according to working with an NBCT, we explore which controls in Table 6 explain why the model presents no statistical effect of NBCTs. In particular, we decompose the change in the coefficient on NBCTs from a null model (-0.0002) to the full model in Table 6, column 1 (-0.0004) to investigate the contribution of having an NBCT on attrition relative to other factors that may be correlated with this pairing (Gelbach, 2016). We find that nearly the entire differential in mean attrition between candidates supervised by NB teachers and non-NB teachers is explained by controlling for year effects; that is, candidates in later years are more likely to be supervised by an NBCT (see Figure 1) *and* less likely to leave the workforce.

5.5 Are candidates supervised by NBCTs more effective teachers?

In Table 7 we present estimates from Equation (3), which assesses the extent to which NBCTs might transfer their efficacy to candidates. We predict math value added for all the years

we observe in the value added sample (first panel) and just for hired candidates' first two years teaching (second panel). Each model includes year fixed effects, models in the second and fifth columns control for cooperating teacher value added, while models in the third and sixth columns include school fixed effects. While we include several potential predictors of teacher value added, the variable of interest in these regressions is "NBCT," a binary variable indicating if the candidate trained with an NBCT. For each measure of value added and all specifications, the NBCT coefficient is not statistically different than zero and (in the case of all years of data) represents a relationship with value added of less than a quarter of a percentage point of an SD. Moreover, the standard error on these estimates is very small in the full sample, about 0.01 SDs of student performance, so we can rule out with 95% confidence relationships of more than about 0.025 SDs of student performance in either direction.

We see similar patterns for ELA value added in Table 8, with estimates pooled across all hired candidates (column 1) and comparing hired candidates across schools (column 2). These patterns suggest that working with an NBCT may even have a negative relationship with hired candidates' value added in ELA. This result is not robust to the inclusion of school fixed effects (column 3) or when we focus on early-career value added (columns 4-6). We conclude that—despite the relationship between cooperating teacher effectiveness and candidates' future effectiveness found in the prior literature and shown in the additional rows of Tables 7 and 8—little of this relationship is captured by working with an NBCT. In conclusion, we do not find evidence of a positive relationship between NBCTs and early-career teaching effectiveness, but as discussed in the previous section, we cannot rule out the very modest association expected based on differences in cooperating teacher effectiveness alone.

6. Conclusion

The emerging literature on student teaching placements and student and teacher outcomes finds strong evidence that cooperating teachers matter for teacher candidate development and future outcomes. Identifying who will be an effective cooperating teacher, however, is not straightforward in part because measures such as evaluation ratings and value added estimates are not readily accessible for the entire pool of potential cooperating teachers. School districts and TEPs therefore lack a straightforward way to determine who should serve as a cooperating teacher. Having NB teachers serve in this capacity is a potential solution, given that NB teacher status signals teacher quality in several studies (e.g., Goldhaber & Cowan, 2015) and the certification involves development of a reflective teaching practice. As we note at the outset of this paper, some school districts appear to be pursuing this solution by pushing NB teachers to become cooperating teachers (Espinoza et al., 2018).

We investigate this issue further by examining (a) the likelihood that NB teachers serve as cooperating teachers and (b) the relationship between having an NBCT and a range of outcomes (e.g., the odds that a candidate ends up employed in the teacher workforce and, contingent on employment, their estimated impact on students). On the first question, we find strong evidence that NB teachers in Washington are far more likely than non-NB teachers to serve in a cooperating teacher role. On the second question, we find that having an NBCT significantly predicts the odds that candidates end up employed as K-12 public school teachers within three years. We cannot, however, determine the degree to which this association relates to skills learned while apprenticing with NB teachers (e.g., NBCTs help develop skills that make candidates more employable), networking effects (e.g., NBCTs help candidates connect to people who help them obtain employment), or selection on unobservable factors (e.g., candidates who are already more likely to become teachers seek out NBCTs).

Although working with an NBCT predicts the likelihood that a candidate is hired to teach, we find little difference in retention or value added among hired candidates—and a slightly negative difference in ELA—compared to their peers who did not have an NBCT. One important caveat is that our effectiveness analysis focuses solely on value added to student test scores. Recent research (e.g., Backes et al., 2022; Jackson, 2018; Kraft, 2019) has found that teachers also contribute to consequential non-test outcomes of students (e.g., attendance, course grades, grade progression, discipline, and college-going); further emerging evidence explores associations between cooperating teacher assignments and teacher contributions to non-test student outcomes (Backes et al., 2023). Whether having an NBCT influences the ability of teachers to contribute to students' non-test outcomes, or outcomes in subjects which are not tested, is unknown and represents a potentially fruitful area for future research, particularly since NB certification may be more aligned to teacher skill areas better captured by non-test outcomes.

An additional area of inquiry that would extend this research could explore more proximal outcomes to the student-teaching experience and dimensions of teaching that are developed through the National Board Certification process. Research on pre-service teacher outcomes, such as the edTPA portfolio assessment (Bastian et al., 2022), finds a relationship between NBCTs and candidate performance, suggesting NBCTs may support preparedness along other dimensions of teaching, even if they do not have large impacts on longer-term outcomes like value added and retention. Additionally, there are meaningful differences in the structures of student-teaching across the country and across programs in our sample. While we control for this with institution fixed effects in our models, future research could assess how these differences mediate the relationship between cooperating teacher characteristics and candidate outcomes.

Furthering our understanding of how to best prepare teacher candidates for the workforce is imperative to improving the overall quality of our next generation of teachers.

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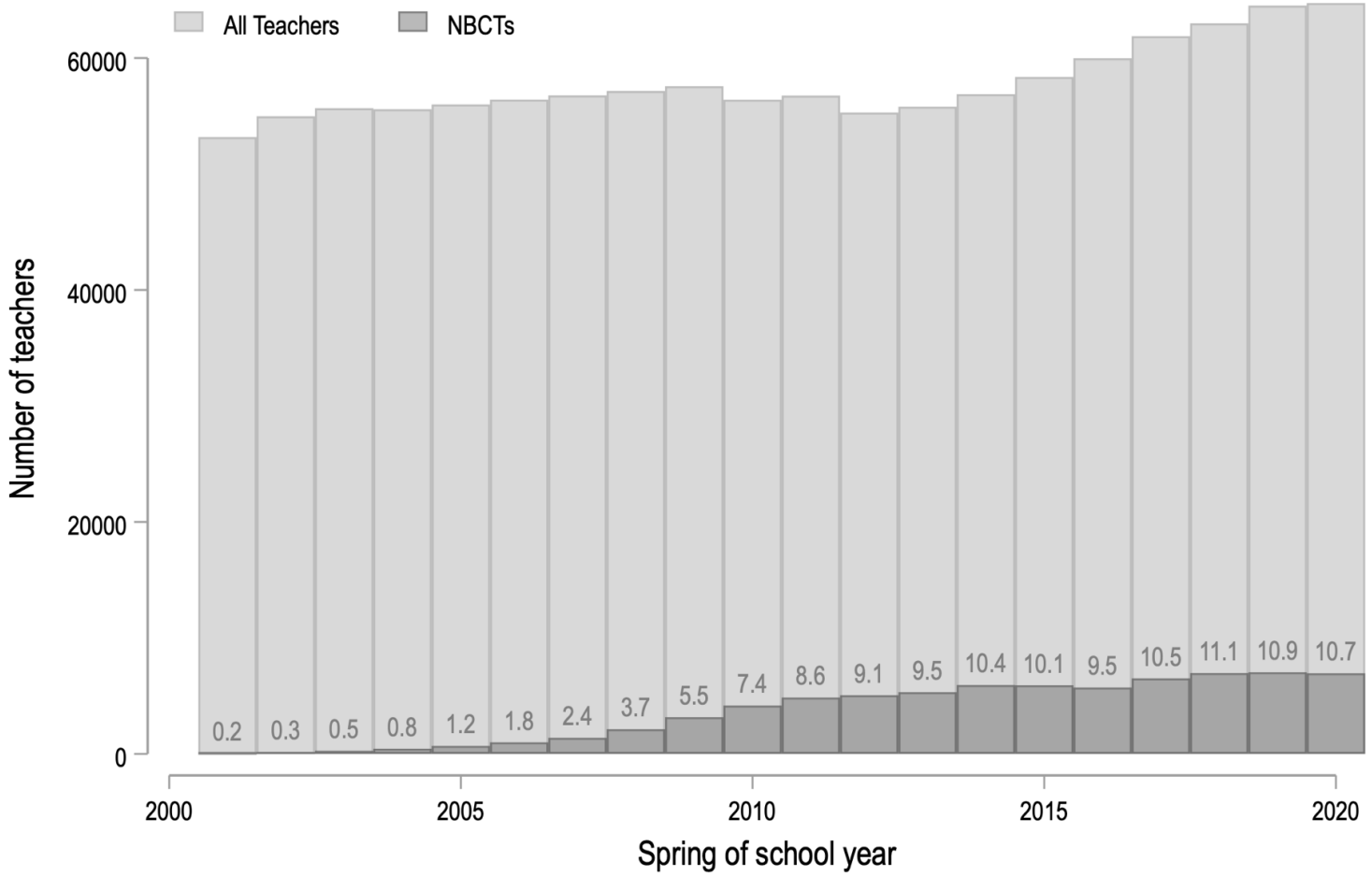
Figures and Tables

Figure 1. National Board Teachers as a Share of All Teachers in Washington Over Time



Notes: Light grey bars represent the total staff of teachers in each year, dark grey bars capture the portion of teaching staff who are National Board certified in that year. Percentage of all staff who are NB teachers are displayed over each bar.

Table 1. Descriptive Statistics of Washington Teaching Staff by Cooperating Teacher Status

	All	CTs	Non-CTs
Panel A: Characteristics			
% NB teachers	10.64	18.70***	10.37
Age	47.39	45.84***	47.44
Experience(years)	15.43	14.86***	15.45
% female	72.82	77.50***	72.66
% male	27.18	22.50***	27.34
% race non-White	7.35	7.91	7.33
% race missing	1.13	1.29	1.13
% graduate degree	69.72	73.99***	69.57
% observed TEP graduate	56.73	61.85***	56.56
% STEM-endorsed	13.22	12.87	13.23
% SPED-endorsed	16.64	15.74*	16.67
% ELL-endorsed	3.29	3.44	3.29
% Elem-endorsed	38.18	43.92***	37.98
% other endorsement	23.53	20.81***	23.62
WEST-B math score	276.07	277.42*	276.02
WEST-B read score	272.83	273.79*	272.79
WEST-B writing score	263.47	264.41	263.43
School stay ratio (%)	22.35	21.19	22.39
School % URM	22.43	24.33***	22.37
School openings	14.15	12.72***	14.20
Ln(mi to nearest TEP)	1.44	1.00***	1.45
% urban districts	32.03	46.56***	31.55
% suburban districts	52.21	45.28***	52.44
% town districts	9.18	4.50***	9.33
% rural districts	6.59	3.66***	6.68
N	222,251	7,204	215,047
Panel B: Value added Subsamples by Subject			
Math % SD VA	1.95	3.58**	1.89
N	29,212	1,153	28,059
Reading % SD VA	1.91	2.73*	1.88
N	30,302	1,196	29,106

Notes: Values are across teacher-years spanning 2010 through 2015 with at least three years of experience, currently working in districts west of the Cascade mountains. Stars in the CT columns indicate statistically significant averages relative to the Non-CT column (*p<0.05, **p<0.01, ***p<0.001). Panel A presents general characteristics of each subsample. Panel B presents observed value added scores and the associated subsample size. CT=cooperating teacher; ELA=English language arts; ELL=English language learner; NB=National Board certified; SD=standard deviation; SPED=special education; STEM=science, technology, math; TEP=teacher education program; URM=under-represented minority; VA=value added.

Table 2. Descriptive Statistics of Candidates by Cooperating Teacher National Board Certification Status

	Sample 1: All Interns		Sample 2: Hired Interns		Sample 3: Value added	
	NBCT	Non-NBCT	NBCT	Non-NBCT	NBCT	Non-NBCT
% NBCT	100.00	0.00	100.00	0.00	100.00	0.00
CT experience	13.50***	14.97	13.50***	14.88	13.01***	14.73
CT % female	79.91***	76.34	80.49***	76.74	84.04***	80.50
CT % male	19.94***	22.98	19.42**	22.57	15.88***	18.74
CT % non-White	6.29*	7.36	6.52	7.46	7.50	6.81
CT % grad degree	0.77	0.72	0.83	0.74	82.19***	67.31
CT average VA	4.12**	2.12	3.95*	1.99	2.54	2.24
CT % match gender	74.72	75.93	74.02	75.04	72.24	73.15
CT % match endorse	83.83***	76.49	89.64***	83.84	80.81***	74.00
CT % match TEP	21.15***	24.34	21.45**	24.24	21.41***	24.70
Age	29.35	29.20	29.24	29.22	29.65	29.67
% female	72.41**	74.74	75.22	76.84	74.92	76.51
% male	24.00	22.38	24.78	23.16	25.08	23.48
% non-White	6.62	6.89	11.37	10.44	11.26*	9.66
% race missing	55.14***	47.26	2.54***	1.50	2.41	1.95
% STEM-endorsed	20.97***	12.21	21.78***	13.13	17.26***	11.37
% SPED-endorsed	9.18***	11.76	10.17***	13.78	9.00***	11.45
% ELL-endorsed	8.31**	6.70	9.06**	7.09	9.00***	6.38
% Elem-endorsed	40.21***	48.79	40.13***	48.03	52.09***	63.71
% other endorsement	23.89*	21.97	23.95**	20.87	15.80***	9.95
% prior experience	2.12	2.01	2.64	2.49	4.66***	3.27
WEST-B math score	279.77***	277.28	280.21***	277.35	281.10***	278.27
WEST-B reading score	272.64***	271.11	272.73***	271.07	272.69	272.06
WEST-B writing score	265.42***	262.84	265.68***	262.96	265.87***	263.98
% ST stay ratio	9.28**	13.91	7.18**	12.83	4.59***	12.44
% ST URM	26.91***	24.49	27.28***	24.70	27.26***	24.29
% ST fall	18.77	17.80	18.22	17.81	15.24**	13.27
% ST winter	21.81***	15.79	21.78***	16.05	16.39	15.16
% ST spring	40.32***	35.87	41.33***	36.49	44.31***	33.77
% ST summer	1.87	1.71	1.99	1.72	1.86**	1.22
% Hired same level			74.94	73.80	68.56*	70.72
% Hired same school			14.75	14.92	12.80	11.92
% Hired same district			38.60	38.67	39.93	39.05
% Hired stay ratio			-15.13	-14.21	-23.91***	-17.41
% Hired sch URM			29.14	29.34	29.03	29.53
% Attrit			30.98***	39.03		
VA Math					-0.77	-0.39
VA ELA					-0.75	-0.23
N	2,733	17,745	2,163	13,624	2,532	19,051

Notes: *p<0.05, **p<0.01, ***p<0.001. Stars in the NBCT columns indicate statistically significant averages relative to the Non-NBCT column to their immediate right. CT=cooperating teacher; ELA=English language arts; ELL=English language learner; NBCT=National Board Cooperating Teacher; SPED=special education; ST=student teaching; STEM=science, technology, math; TEP=teacher education program; URM=under-represented minority; VA=value added.

Table 3. Relationships Between Teacher and School Variables and the Probability of Hosting a Student Teacher

	(1)	(2)	(3)	(4)
NB Teacher	0.0189***	0.0188***	0.0195***	0.0801**
	(0.0012)	(0.0012)	(0.0013)	(0.0252)
Teacher master's plus	0.0066***	0.0065***	0.0084***	0.104***
	(0.0010)	(0.0010)	(0.0011)	(0.0296)
Teacher female (ref. male)	0.0063***	0.0064***	0.0074***	
	(0.0011)	(0.0011)	(0.0012)	
Teacher non-White	-0.0025	-0.0026	-0.0008	
	(0.0018)	(0.0017)	(0.0018)	
Teacher graduated from observed TEP	0.0115***	0.0113***	0.0053***	
	(0.0012)	(0.0012)	(0.0012)	
Teacher STEM-endorsed (ref. Elem)	-0.0032*	-0.0028	-0.0020	-0.127
	(0.0015)	(0.0016)	(0.0017)	(0.0938)
Teacher SPED-endorsed (ref. Elem)	-0.0027	-0.0021	-0.0033*	0.154
	(0.0014)	(0.0014)	(0.0015)	(0.2049)
Teacher ELL-endorsed (ref. Elem)	-0.0019	-0.0016	-0.0040	0.0567
	(0.0026)	(0.0026)	(0.0027)	(0.0891)
Teacher Other endorsement (ref. Elem)	-0.0053***	-0.0045***	-0.0041**	0.253
	(0.0012)	(0.0012)	(0.0014)	(0.1594)
School % URM students	0.0034	0.0038		
	(0.0032)	(0.0032)		
School teacher openings next year	-0.0001*	-0.0001		
	(0.0001)	(0.0001)		
Teacher VA math		0.0064	0.0030	-0.0297
		(0.0060)	(0.0068)	(0.0712)
Teacher VA ELA		0.0013	-0.0088	-0.0933
		(0.0080)	(0.0090)	(0.0919)
Year effects	X	X	X	X
School effects			X	
Teacher effects				X
N	213,857	213,857	198,633	30,108
Pseudo-R^2	0.03	0.03	0.09	0.01

Notes: *p<.05, **p<.01, ***p<.001, standard errors clustered by teacher. All estimates are for the subsample of teacher-years in districts west of the Cascades with at least three years of experience. Controls included in the model but not shown in table: teacher experience (years), the number of endorsements a teacher holds, indicators for district urbanicity, the interaction between an indicator for graduates from an observed TEP program and the log distance to that program from their current district, the log distance to nearest TEP and its square, school stay ratio, and the school certified and classified staff per 100 students. For all models we include indicators for missing teacher value added in both subjects and replace missing observations with the sample mean. ELA=English language arts; ELL=English language learner; NB=National Board certified; SPED=special education; STEM=science, technology, math; TEP=teacher education program; URM=under-represented minority; VA=value added.

Table 4. Relationships Between Candidate Variables and the Probability of Matching with an NBCT

	(1)	(2)	(3)	(4)	(5)	(6)
Candidate age	0.000615	0.000617	0.000149	0.000428	0.000520	0.000149
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0003)	(0.0004)
Candidate female (ref. male)	-0.0136	0.00298	0.00195	-0.0106	0.00356	0.00207
	(0.0080)	(0.0050)	(0.0049)	(0.0078)	(0.0050)	(0.0049)
Candidate non-White	-0.00150	-0.000284	-0.00430	0.00312	0.00250	-0.00330
	(0.0056)	(0.0065)	(0.0082)	(0.0056)	(0.0065)	(0.0086)
Candidate STEM-endorsed (ref. Elem)		0.0693***	0.0643***		0.0645***	0.0633***
		(0.0124)	(0.0117)		(0.0122)	(0.0111)
Candidate SPED-endorsed (ref. Elem)		-0.0265*	-0.0314**		-0.0262*	-0.0311*
		(0.0121)	(0.0121)		(0.0118)	(0.0121)
Candidate ELL-endorsed (ref. Elem)		0.00945	0.00678		0.00872	0.00665
		(0.0131)	(0.0094)		(0.0128)	(0.0097)
Candidate other endorsement (ref. Elem)		0.0267	0.0228		0.0244	0.0222
		(0.0138)	(0.0136)		(0.0137)	(0.0133)
Candidate WEST-B score (average)				0.00105***	0.000572**	0.0000996
				(0.0002)	(0.0002)	(0.0003)
Candidate WEST-B attempts				-0.00311	-0.00759	-0.0100
				(0.0113)	(0.0113)	(0.0115)
Intern year effects	X	X	X	X	X	X
Institution effects			X			X
N	20,478	20,478	20,478	20,478	20,478	20,478
Pseudo-R^2	0.06	0.07	0.07	0.06	0.07	0.07

Notes: *p<.05, **p<.01, ***p<.001, standard errors clustered at TEP institution level. For all models we include indicators for missing WEST-B scores and replace all missing scores with zeros. ELL=English language learner; NBCT=National Board Cooperating Teacher; SPED=special education; STEM=science, technology, math; TEP=teacher education program.

Table 5. Relationships Between CT and Candidate Variables and the Probability of Teaching Workforce Entry

	Hired within 1 year of student teaching			Hired within 3 years of student teaching		
	(1)	(2)	(3)	(4)	(5)	(6)
NBCT	-0.0003	-0.0006	-0.0008	0.0177*	0.0175*	0.0174*
	(0.0133)	(0.0133)	(0.0134)	(0.0079)	(0.0079)	(0.0079)
CT female (ref. male)	0.0131	0.0135	0.0133	0.0167**	0.0169**	0.0169**
	(0.0093)	(0.0093)	(0.0091)	(0.0062)	(0.0063)	(0.0063)
CT non-White	0.0120	0.0131	0.0129	0.0095	0.0099	0.0099
	(0.0102)	(0.0100)	(0.0101)	(0.0069)	(0.0069)	(0.0070)
CT gender match	-0.0146	-0.0144	-0.0146	-0.0097	-0.0097	-0.0098
	(0.0101)	(0.0101)	(0.0100)	(0.0093)	(0.0093)	(0.0093)
CT endorsement match	0.0448***	0.0442***	0.0445***	0.0256***	0.0254***	0.0254***
	(0.0077)	(0.0080)	(0.0079)	(0.0074)	(0.0074)	(0.0074)
CT institution match	-0.0253**	-0.0247**	-0.0248**	-0.0037	-0.0035	-0.0036
	(0.0092)	(0.0092)	(0.0092)	(0.0100)	(0.0100)	(0.0100)
CT VA math			0.0253			0.0312
			(0.0546)			(0.0481)
CT VA ELA			0.126			0.0106
			(0.1130)			(0.1130)
Candidate female	0.0174*	0.0188**	0.0190**	-0.0110	-0.0109	-0.0107
	(0.0069)	(0.0072)	(0.0071)	(0.0091)	(0.0096)	(0.0097)
Candidate non-White	0.0107	0.0166*	0.0165*	-0.0169	-0.0152	-0.0152
	(0.0084)	(0.0084)	(0.0083)	(0.0132)	(0.0129)	(0.0129)
Candidate STEM-endorsed (ref. Elem)	0.164***	0.155***	0.155***	0.115***	0.113***	0.113***
	(0.0249)	(0.0242)	(0.0242)	(0.0222)	(0.0211)	(0.0212)
Candidate SPED-endorsed (ref. Elem)	0.163***	0.165***	0.166***	0.185***	0.185***	0.186***
	(0.0254)	(0.0261)	(0.0262)	(0.0178)	(0.0181)	(0.0181)
Candidate ELL-endorsed (ref. Elem)	0.0773***	0.0752***	0.0751***	0.0622***	0.0618***	0.0617***
	(0.0159)	(0.0159)	(0.0161)	(0.0158)	(0.0154)	(0.0155)
Candidate other endorsement (ref. Elem)	0.0286*	0.0253*	0.0252*	0.0024	0.0017	0.0018
	(0.0124)	(0.0127)	(0.0127)	(0.0126)	(0.0128)	(0.0128)
Candidate prior teaching experience	0.497***	0.493***	0.493***	0.407***	0.406***	0.406***
	(0.0656)	(0.0653)	(0.0649)	(0.0787)	(0.0788)	(0.0785)
Candidate WEST-B score (average)		0.0013**	0.0013**		0.0002	0.0002
		(0.0005)	(0.0005)		(0.0006)	(0.0006)
N	20,478	20,478	20,478	20,478	20,478	20,478
Pseudo-R^2	0.17	0.17	0.17	0.15	0.15	0.15

Notes: *p<.05, ** p<.01, ***p<.001. Standard errors are clustered by TEP institution. All models include intern year effects and TEP fixed effects. Controls included in the model but not shown in table: CT experience, CT master's plus (indicator), ST school stay ratio, ST school percentage of URM students, ST school teacher openings next year, ST district urbanicity (indicators), ST quarter (indicators), candidate WEST-B number of attempts. Models controlling for WEST-B also include an indicator for WEST-B score missingness and replace missing scores with zeros. Models controlling for CT value added include indicators for missingness in each variable and replace missing values with the sample mean. CT=cooperating teacher; ELA=English language arts; ELL=English language learner; NBCT=National Board Cooperating Teacher; SPED=special education; ST=student teaching; STEM=science, technology, math; TEP=teacher education program; URM=under-represented minority; VA=value added.

Table 6. Relationships Between CT, Student Teaching and Candidate Variables and Probability of Attrition

	Attrition			Early-Career Attrition		
	(1)	(2)	(3)	(4)	(5)	(6)
NBCT	-0.000408	-0.000412	-0.00149	-0.00390	-0.00389	-0.00948
	(0.0029)	(0.0029)	(0.0033)	(0.0050)	(0.0050)	(0.0066)
CT female (ref. male)	-0.0028	-0.0028	-0.0027	-0.0025	-0.0024	-0.0014
	(0.0025)	(0.0025)	(0.0028)	(0.0043)	(0.0043)	(0.0057)
CT non-White	-0.0021	-0.0021	-0.0020	-0.0047	-0.0047	-0.0028
	(0.0035)	(0.0035)	(0.0040)	(0.0065)	(0.0065)	(0.0086)
CT gender match	0.0004	0.0003	0.0011	-0.0027	-0.0027	-0.0021
	(0.0024)	(0.0024)	(0.0027)	(0.0041)	(0.0041)	(0.0054)
CT endorsement match	-0.0038	-0.0038	-0.0011	-0.0095*	-0.0095*	-0.0052
	(0.0025)	(0.0025)	(0.0030)	(0.0045)	(0.0045)	(0.0062)
CT institution match	-0.0073***	-0.0073***	-0.0067**	-0.0033	-0.0033	-0.0036
	(0.0022)	(0.0022)	(0.0025)	(0.0040)	(0.0040)	(0.0054)
CT VA Math		0.0260	0.0261		0.0161	0.0151
		(0.0176)	(0.0208)		(0.0312)	(0.0433)
CT VA ELA		-0.0345	-0.0408		-0.0469	-0.0435
		(0.0220)	(0.0255)		(0.0382)	(0.0508)
Years until hired	0.0027***	0.0027***	0.0030***	0.0070***	0.0070***	0.0088***
	(0.0007)	(0.0007)	(0.0008)	(0.0009)	(0.0009)	(0.0013)
Candidate age	-0.0003*	-0.0003*	-0.0003	0.0012***	0.0012***	0.0015***
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0003)
Candidate female (ref.	0.0108***	0.0108***	0.0123***	0.0015	0.0015	0.0013
male)	(0.0024)	(0.0024)	(0.0028)	(0.0042)	(0.0042)	(0.0056)
Candidate non-White	0.0019	0.0019	-0.0012	0.0029	0.0030	0.0007
	(0.0031)	(0.0031)	(0.0035)	(0.0055)	(0.0055)	(0.0074)
Candidate STEM-	-0.0013	-0.0014	-0.0045	0.0071	0.0071	-0.0064
endorsed (ref. Elem)	(0.0031)	(0.0031)	(0.0041)	(0.0053)	(0.0053)	(0.0085)
Candidate SPED-	-0.0043	-0.0044	-0.0078*	-0.0194***	-0.0195***	-0.0349***
endorsed (ref. Elem)	(0.0029)	(0.0029)	(0.0034)	(0.0057)	(0.0057)	(0.0079)
Candidate ELL-	-0.0071	-0.0071	-0.0102*	-0.0180*	-0.0180*	-0.0257**
endorsed (ref. Elem)	(0.0038)	(0.0038)	(0.0045)	(0.0072)	(0.0072)	(0.0095)
Candidate WEST-B	0.0004***	0.0004***	0.0003**	0.0004*	0.0004*	0.0004
score (average)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
Candidate VA Math		-0.0326*	-0.0358*		-0.0389	-0.0412
		(0.0156)	(0.0172)		(0.0318)	(0.0418)
Candidate VA ELA		-0.0358	-0.0313		-0.0983**	-0.0863
		(0.0192)	(0.0210)		(0.0376)	(0.0489)
School effects			X			X
N	83,772	83,772	77,440	29,296	29,296	22,554
R-squared	0.01	0.01	0.05	0.03	0.03	0.09

Notes: *p<.05, ** p<.01, ***p<.001. Standard errors are clustered at the teacher level. All models include year effects and the following control variables: CT experience, CT master's plus (indicator); for both ST school and current school stay ratio, percentage of URM students, district urbanicity (indicators); ST quarter (indicators); candidate years of experience teaching (indicators); candidate WEST-B number of attempts, candidate has other endorsement; match (indicators) between current and ST school level, school, and district. Models controlling for WEST-B include an indicator for WEST-B missingness and replace missing scores with zeros. Models controlling for value added include indicators for missingness in each variable and replace missing values with the sample mean. CT=cooperating teacher; ELA=English language arts; ELL=English language learner; NBCT=National Board Cooperating Teacher; SPED=special education; ST=student teaching; STEM=science, technology, math; TEP=teacher education program; URM=under-represented minority; VA=value added.

Table 7. Relationships Between CT, Student Teaching and Candidate Variables and Math Teacher Value Added

	Math VA			Early-Career Math VA		
	(1)	(2)	(3)	(4)	(5)	(6)
NBCT	-0.0016	-0.0021	-0.0071	-0.0112	-0.0121	0.0148
	(0.0106)	(0.0106)	(0.0096)	(0.0172)	(0.0171)	(0.0314)
CT female (ref. male)	0.00360	0.0036	0.0113	-0.0076	-0.0074	0.0118
	(0.0092)	(0.0092)	(0.0089)	(0.0197)	(0.0196)	(0.0303)
CT non-White	-0.0074	-0.0077	-0.0269*	-0.0213	-0.0264	-0.0819*
	(0.0143)	(0.0144)	(0.0126)	(0.0255)	(0.0260)	(0.0374)
CT gender match	0.0055	0.0041	0.0020	-0.0007	-0.0065	-0.0208
	(0.0094)	(0.0094)	(0.0085)	(0.0195)	(0.0193)	(0.0308)
CT endorsement match	0.0013	0.0019	-0.0020	0.0257	0.0291	0.0162
	(0.0084)	(0.0084)	(0.0080)	(0.0203)	(0.0202)	(0.0319)
CT institution match	-0.0006	-0.0014	0.0177*	-0.0029	-0.0039	-0.0214
	(0.0087)	(0.0086)	(0.0084)	(0.0175)	(0.0173)	(0.0272)
CT math VA		0.0654	0.0832*		0.164**	0.221*
		(0.0397)	(0.0380)		(0.0555)	(0.0924)
Candidate age	-0.0008	-0.0008	-0.0011*	-0.0013	-0.0011	-0.0004
	(0.0005)	(0.0005)	(0.0004)	(0.0008)	(0.0008)	(0.0017)
Candidate female (ref. male)	0.0015	0.0025	-0.0050	0.0024	0.0087	0.0082
	(0.0093)	(0.0094)	(0.0083)	(0.0196)	(0.0195)	(0.0327)
Candidate non-White	0.0027	0.0026	0.0003	0.0353	0.0342	0.0186
	(0.0115)	(0.0115)	(0.0108)	(0.0214)	(0.0214)	(0.0347)
Candidate STEM-endorsed (ref. Elem)	0.0004	0.0004	0.0154	0.0490*	0.0486*	0.108**
	(0.0104)	(0.0104)	(0.0110)	(0.0204)	(0.0201)	(0.0416)
Candidate SPED-endorsed (ref. Elem)	-0.0446***	-0.0446***	-0.0483**	-0.0439	-0.0453	-0.0404
	(0.0129)	(0.0129)	(0.0150)	(0.0237)	(0.0237)	(0.0456)
Candidate ELL-endorsed (ref. Elem)	-0.0067	-0.0062	-0.0258	-0.0207	-0.0175	-0.0336
	(0.0159)	(0.0158)	(0.0154)	(0.0314)	(0.0311)	(0.0466)
Candidate prior teaching experience	0.0414	0.0392	0.0153	-0.0754	-0.0758	-0.248*
	(0.0234)	(0.0239)	(0.0166)	(0.0720)	(0.0689)	(0.1048)
Candidate WEST-B score (average)	0.0004	0.0004	0.0001	-0.0008	-0.0010	-0.0018
	(0.0004)	(0.0004)	(0.0003)	(0.0007)	(0.0007)	(0.0010)
Match school level	0.0020	0.0026	-0.0116	0.0270	0.0285	-0.0055
	(0.0092)	(0.0091)	(0.0092)	(0.0178)	(0.0177)	(0.0364)
Match school	0.0064	0.0060	0.0116	0.0013	-0.0007	-0.0515
	(0.0114)	(0.0113)	(0.0111)	(0.0241)	(0.0239)	(0.0382)
Match district	0.0151	0.0153	0.0034	0.0277	0.0298	0.0441
	(0.0082)	(0.0082)	(0.0073)	(0.0176)	(0.0176)	(0.0292)
Current school stay ratio	0.0163***	0.0163***		0.0231**	0.0247**	
	(0.0039)	(0.0038)		(0.0083)	(0.0083)	
School effects			X			X
N	12,404	12,404	12,404	1,368	1,368	1,368
R-squared	0.04	0.04	0.33	0.08	0.09	0.71

Notes: *p<.05, ** p<.01, ***p<.001. Standard errors are clustered by teacher. All models include year effects and the following controls: CT experience, CT master's plus; for both ST school and current school stay ratio, percentage of URM students, district urbanicity; ST quarter; candidate WEST-B number of attempts, candidate other endorsement, candidate years of experience (indicators). Models controlling for WEST-B and CT VA include indicators for missingness and replace missing scores with zeros and the sample mean, respectively.
CT=cooperating teacher; ELA=English language arts; ELL=English language learner; NBCT=National Board Cooperating Teacher; SPED=special education; ST=student teaching; STEM=science, technology, math; TEP=teacher education program; URM=under-represented minority; VA=value added.

Table 8. Relationships Between CT, Student Teaching and Candidate Variables and ELA Teacher Value Added

	ELA VA			Early-Career ELA VA		
	(1)	(2)	(3)	(4)	(5)	(6)
NBCT	-0.0169*	-0.0168*	-0.0105	-0.0171	-0.0174	-0.0322
		(0.0071)	(0.0068)	(0.0137)	(0.0137)	(0.0264)
CT female (ref. male)	0.0043	0.0039	0.0125	0.0091	0.0070	-0.0007
	(0.0071)	(0.0071)	(0.0068)	(0.0156)	(0.0156)	(0.0315)
CT non-White	0.0076	0.0075	-0.0185	0.0043	0.0049	-0.0248
	(0.0098)	(0.0098)	(0.0099)	(0.0212)	(0.0208)	(0.0392)
CT gender match	0.0048	0.0048	-0.0096	-0.0040	-0.0032	-0.0042
	(0.0070)	(0.0070)	(0.0067)	(0.0155)	(0.0154)	(0.0289)
CT endorsement match	-0.0009	-0.0007	0.0022	0.0009	0.0013	0.0104
	(0.0063)	(0.0063)	(0.0059)	(0.0145)	(0.0145)	(0.0260)
CT institution match	-0.0026	-0.0031	-0.0049	0.0040	0.0032	0.0171
	(0.0061)	(0.0061)	(0.0058)	(0.0139)	(0.0139)	(0.0244)
CT ELA VA		0.0647	0.0236		0.139*	0.205
		(0.0370)	(0.0356)		(0.0695)	(0.1116)
Candidate age	-0.0002	-0.0003	0.0001	0.0001	0.0002	-0.0014
	(0.0004)	(0.0004)	(0.0003)	(0.0009)	(0.0009)	(0.0018)
Candidate female (ref.	0.0016	0.0019	0.0142*	-0.0124	-0.0109	-0.0233
male)	(0.0071)	(0.0070)	(0.0067)	(0.0160)	(0.0159)	(0.0305)
Candidate non-White	-0.0036	-0.0034	-0.0068	-0.0173	-0.0147	-0.0108
	(0.0087)	(0.0088)	(0.0083)	(0.0178)	(0.0178)	(0.0299)
Candidate STEM-endorsed	-0.0108	-0.0117	-0.0091	-0.0116	-0.0136	-0.0418
(ref. Elem)	(0.0202)	(0.0198)	(0.0163)	(0.0279)	(0.0276)	(0.0541)
Candidate SPED-endorsed	-0.0117	-0.0115	-0.0066	0.0001	0.0023	0.0079
(ref. Elem)	(0.0094)	(0.0094)	(0.0099)	(0.0236)	(0.0238)	(0.0473)
Candidate ELL-endorsed	-0.0083	-0.0080	-0.0098	-0.0150	-0.0118	-0.0111
(ref. Elem)	(0.0090)	(0.0091)	(0.0087)	(0.0167)	(0.0170)	(0.0304)
Candidate prior teaching	0.0851***	0.0835***	0.0374**	-0.337***	-0.331***	-0.187
experience	(0.0174)	(0.0172)	(0.0138)	(0.0394)	(0.0396)	(0.1308)
Candidate WEST-B score	0.0001	0.0001	-0.0001	-0.0007	-0.0007	-0.0010
(average)	(0.0002)	(0.0002)	(0.0002)	(0.0005)	(0.0005)	(0.0009)
Match school level	0.0191**	0.0192**	0.0043	-0.0013	-0.0016	0.0201
	(0.0064)	(0.0064)	(0.0072)	(0.0158)	(0.0158)	(0.0341)
Match school	-0.0057	-0.0064	0.0155	0.0149	0.0133	-0.0167
	(0.0088)	(0.0087)	(0.0081)	(0.0191)	(0.0191)	(0.0320)
Match district	0.0100	0.0099	-0.0032	0.0145	0.0153	0.0086
	(0.0059)	(0.0059)	(0.0059)	(0.0141)	(0.0141)	(0.0262)
Current school stay ratio	0.0021	0.0021		-0.0040	-0.0036	
	(0.0031)	(0.0031)		(0.0071)	(0.0071)	
School effects			X			X
N	12,400	12,400	12,400	1,356	1,356	1,356
R-squared	0.05	0.05	0.29	0.07	0.07	0.65

Notes: *p<.05, ** p<.01, ***p<.001. Standard errors are clustered by teacher. All models include year effects and the following controls: CT experience, CT master's plus; for both ST school and current school stay ratio, percentage of URM students, district urbanicity; ST quarter; candidate WEST-B number of attempts, candidate endorsed other, candidate years of experience (indicators). Models including WEST-B and CT VA include indicators for missingness and replace missing scores with zeros and the sample mean, respectively.
CT=cooperating teacher; ELA=English language arts; ELL=English language learner; NBCT=National Board Cooperating Teacher; SPED=special education; ST=student teaching; STEM=science, technology, math; TEP=teacher education program; URM=under-represented minority; VA=value added.