ESTIMATING THE IMPACT OF PREPARATORY TEACHING EXPERIENCES ON TEACHER RETENTION

A Thesis

Presented to

The Faculty of the Department

of Economics

University of Houston

In Partial Fulfillment

Of the Requirements for the Degree of

Bachelor of Science

By

Michelle Q. Tran

May, 2019

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Abstract

About 21 percent of Texas teachers leave the profession within the first three years of teaching. Taking advantage of variation in required preparatory teaching experience—called student teaching—hours across educator preparation programs (EPPs), this study uses pooled Texas administrative data to adapt Boyd et al.'s (2006) conceptual model of the effects of EPP characteristics on teacher retention. A logistic regression with year and program fixed effects estimates substantial gains from increasing the number of hours required for student teaching. In fact, increasing the number of hours required for student teaching from one semester (0-300 hours) to two semesters (301-600 hours) can increase the odds of retaining a teacher for one year by 54.4 percent. An increase from one to four semesters of student teaching is correlated with a 70.9 percent increase the odds two-year teacher retention. A state mandate for two semesters of student teaching would raise the state's one-year teacher retention rate to 74.6 percent and a mandate for four semesters of student teaching would raise the state's two-year retention rate to 63.4 percent. However, there are decreasing marginal returns to additional hours of student teaching in terms of retention. The number of required hours for student teaching represents an important yet singular aspect of teacher preparation and state policies should expand their focus on teacher preparation beyond student teaching requirements.

Acknowledgements

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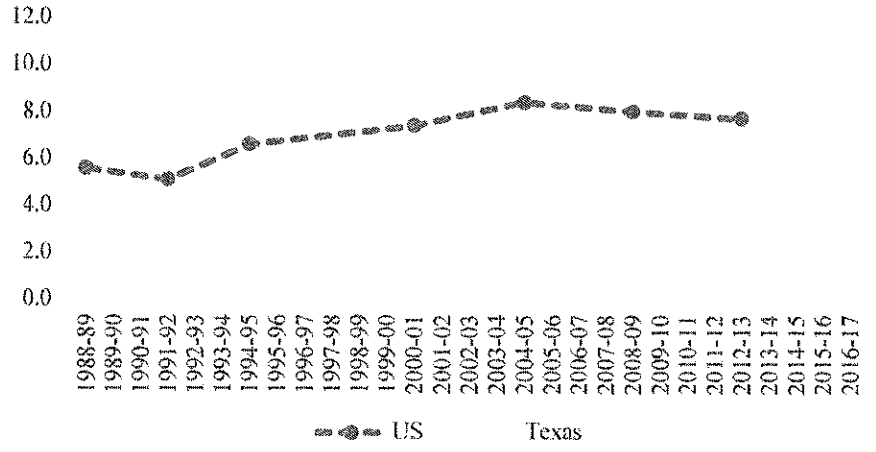
I. Introduction

Teachers hold a crucial role in student achievement (Rivkin et al., 2005). Yet across the United States, schools struggle with retaining their teachers. In academic year (AY) 2012-2013, 7.7 percent of all teachers left the teaching profession. New teachers are particularly difficult to retain. Nearly 20 percent of beginning teachers leave within the first three years of teaching; about 12.5 percent change schools and 7.1 percent leave the teaching profession altogether based on AY 2012-2013 cohort data (Goldring et al., 2014). Teacher turnover is even higher in Texas. About 10.45 percent of all teachers left the profession in AY 2012-2013 and 21 percent of new teachers within the first three years of teaching. Since new teachers constitute about 11 percent of the teacher workforce (Ramsay, 2018), new teacher turnover contributes heavily to the pecuniary cost of teacher attrition—an estimated $108 to $235 million for Texas annually (Haynes et al., 2014). While many teachers who leave the profession eventually return to teaching, this still causes instability in schools and inconsistent instruction (Papay et al., 2017). As a result, recent studies suggests teacher turnover is associated with setbacks in student achievement (Rowan et al., 2002; Rivkin et al., 2005; Hanushek et al., 2005).

Figure 1. Teacher attrition rates in U.S. and Texas, AY 1988-89 to 2016-17



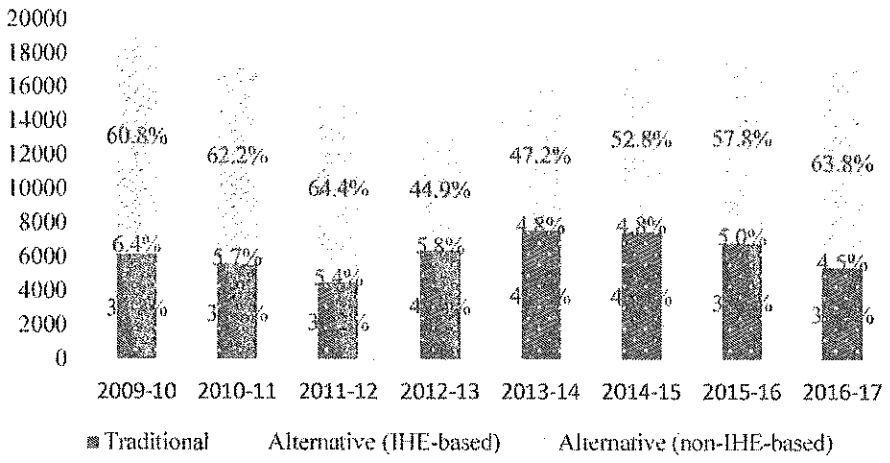
Note: Attrition is defined here as the percentage of all teachers leaving the profession. While the U.S. average attrition rate has remained approximately 8 percent of all teachers in recent years, Texas average attrition rate has consistently remained approximately 2 percentage points higher at 10 percent. One possible explanation to the temporary decline in Texas average attrition rate to 8.5 percent in 2008 is the Great Recession. Due to job insecurity and the stability that the teaching profession offers, teachers are more likely to remain in teaching.

Source: National data obtained from U.S. Department of Education's Teacher Attrition and Mobility: Results From the 2012-13 Teacher Follow-up Survey (Goldring et al., 2014) and Texas data obtained from Texas Education Agency's Employed Teacher Attrition and New Hires 2007-2014 (Ramsay, 2015a) and Employed Teacher Attrition and New Hires 2010-2017 (Ramsay, 2018a).

Concerned with stagnant teacher attrition rates, policymakers turn their attention to how teachers are prepared. Traditionally, educator preparation programs (EPPs) are housed in colleges and universities. Population growth and teacher shortages encourage more alternative EPPs to emerge and enroll non-traditional teacher candidates. Colleges and universities, many of which host a traditional pathway, open their doors to post-baccalaureate teacher candidates in their alternative institution of higher education (IHE) based pathway. Since these programs are located at colleges and universities, they tend to resemble traditional colleges and will at times be grouped together in this study. Other alternative certification programs (ACPs) across the state are run by service organizations, school districts, and for-profits. In 2019, the State Board of Educator Certification (SBEC) recognize 135 EPPS in Texas. Due to many institutions having multiple pathways, 75 of the 135 EPPs are traditional, 78 are alternative IHE-based, and 109 are alternative non-IHE-based[1]. Two important trends emerge between traditional and alternative pathways: (1) alternative (non-IHE-based) EPPs produce more teachers and (2) traditional EPPs have higher retention rates (see **Figure 2** and **Figure 3**).

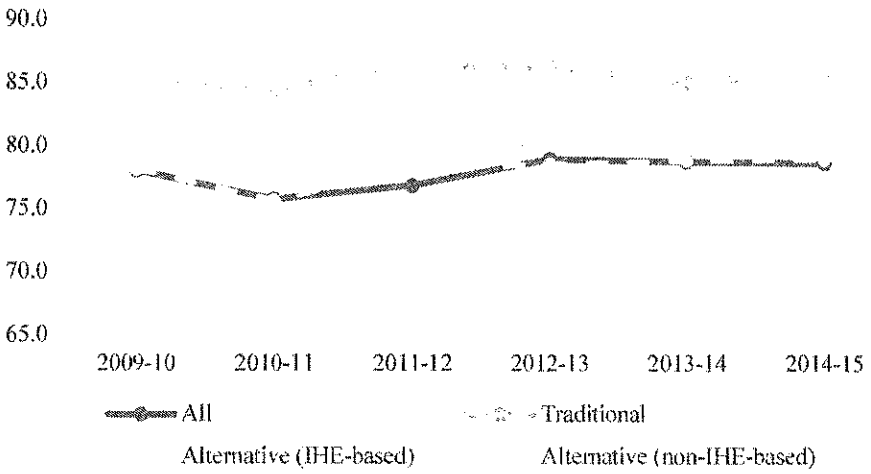
Although factors contributing to teacher retention is complex, EPPs are an important factor on whether a teacher chooses to stay or leave (Boyd et al., 2006). Based on program characteristics such as

Figure 2. New teachers produced by year and pathway in Texas, AY 2009-10 to 2016-17



[1] The most up-to-date list of all Texas Education Agency's accredited EPPs can be found at https://air-esri.maps.arcgis.com/apps/opsdashboard/index.html#/f843bd7cdb3440b59b0b59b5ba656f85.

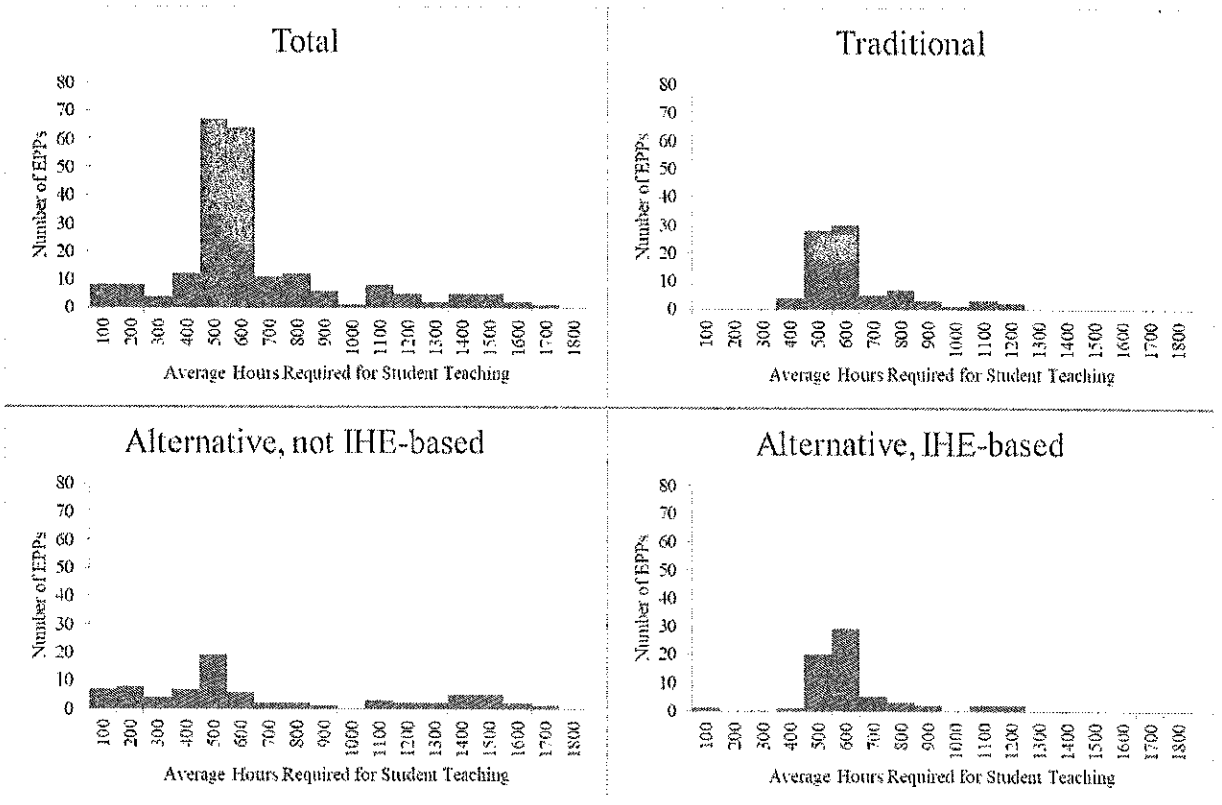
Figure 3. Three-year teacher retention rate by year and pathway in Texas, AY 2009-10 to 2014-15



Note: Retention is defined here as the percentage of new teachers who remain in the profession. This definition of retention includes teachers who change schools. Texas teachers trained in traditional pathways on average have the highest retention rates while teachers trained in alternative pathways not based at an institution of higher education (IHE) typically have the lowest retention rates. Texas teachers trained in alternative IHE-based pathways typically have lower retention rates compared to teachers from traditional pathways but higher than teachers from alternative non-IHE-based pathways.
Source: Texas Education Agency's Teacher Retention 2010-2014 (Ramsay, 2015b) and Teacher Retention 2013-2017 (Ramsay, 2018b).

selectivity and required content, there exists as much variation *within* the three pathways as there are among them (von Hippel et al. 2016). One such variable is the student teaching, or the unsupervised classroom teaching experiences while a teacher candidate is enrolled in an EPP. Student teaching experience is consistently surveyed as "the most valuable aspect of [an] education program" by new teachers (Levine, 2006). Ingersoll and May (2012) observe that pre-service teaching experience increase the probability of a teacher choosing to stay in teaching. Boyd et al. (2008) suggest that teacher candidates benefit from pre-service teaching experiences matching the candidate's future teaching placement.

Figure 4. Distribution of educator preparation programs (EPPs) by average hours required for student teaching and by pathway in Texas, AY 2011-12 to 2015-16



Note: Overall, Texas has a unimodal distribution of average hours required for student teaching. While the majority of educator preparation programs (EPPs) require between 400 and 600 hours, some EPPs require as little as zero student teaching hours and as many as 1796 student teaching hours. Traditional pathways typically have the least variation in average hours required for student teaching across EPPs. Alternative pathways at institutions of higher education (IHE) resembles traditional pathways in the distribution of the average hours required for student teaching. Alternative pathways not at institutions of higher education (IHE) have the most variation in the average number of required hours for student teaching.
Source: U.S. Department of Education's Higher Education Act Title II Reporting System[2]

This study will focus on estimating the relationship of student teaching on the likelihood of a teacher to stay using a logistic regression with time and EPP fixed effects. Due to the selection bias that exists in the teacher's selection of the EPP and the teacher's school placement, this study does not seek to estimate a causal relationship between student teaching and teacher retention. Pooled administrative data on retention, student teaching, other EPP characteristics, school characteristics, and teacher characteristics come from a variety U.S. Department of Education and Texas Education Agency (TEA) maintained databases. Taking advantage of variation in required student teaching hours across EPPs, the logistic

[2] Title II data can be accessed at https://title2.ed.gov/Public/Home.aspx.

regression with year and EPP fixed effects estimates significant gains from increasing the number of hours required for student teaching. Increasing the number of hours required for student teaching from 0-300 hours to 301-600 hours (the equivalent of increasing one semester of student teaching to two semesters) increases the odds of retaining a teacher for one year by 54.4 percent. Increasing the number of hours required for student teaching from 0-300 hours to 901-1200 hours (the equivalent of increasing one semester of student teaching to 4 semesters) increases the odds of retaining a teacher for two years by 70.9 percent. Robustness is checked by an OLS regression with year and EPP fixed effects. Compared to one semester of student teaching, three semesters of student teaching increase the likelihood of retaining a teacher for one year by 0.113. Similarly, four semesters of student teaching increase the likelihood of retaining a teacher for two years by 0.121. Predicting the impact of mandating a certain number of semesters of student teaching and F-testing reveals that student teaching has diminishing marginal returns.

The rest of the paper is outlined as follows: Section II reviews the relevant literature. Section III presents the data. Section IV explains the method used and Section V provides the results. Section VI discusses potential explanations for the estimated relationship and policy implications. Section VII concludes.

II. Literature Review

Previous studies explore factors that influence teachers' decision to stay or leave the profession, including teacher characteristics, school characteristics, and student characteristics. Some teacher demographic information is highly correlated with teacher turnover. While age is a consistent predictor—younger and older teachers are more likely to move or leave teaching compared to middle-aged teachers—gender, race, and ethnicity are less consistent (Johnson et al., 2005; Guarino et al., 2006; Allensworth et al., 2009). Teacher qualities also tend to be indicative of teacher turnover. More qualified teachers (i.e. teachers from more selective colleges and universities or teachers with higher test scores) are more likely to leave teaching (Boyd et al., 2005). Teachers with less experience have higher turnover rates compared to teachers with more experience (Ingersoll, 2001; Marvel et al., 2007). More effective

teachers, in terms of student achievement, are less likely to leave (Boyd et al., 2008; Boyd et al., 2010; Goldhaber et al., 2007; Hanushek et al., 2005). Less observable teacher qualities also impact teacher retention decisions. Particularly among beginning teachers, "grittier" teachers are less likely to leave the profession (Robertson-Kraft and Duckworth, 2014)

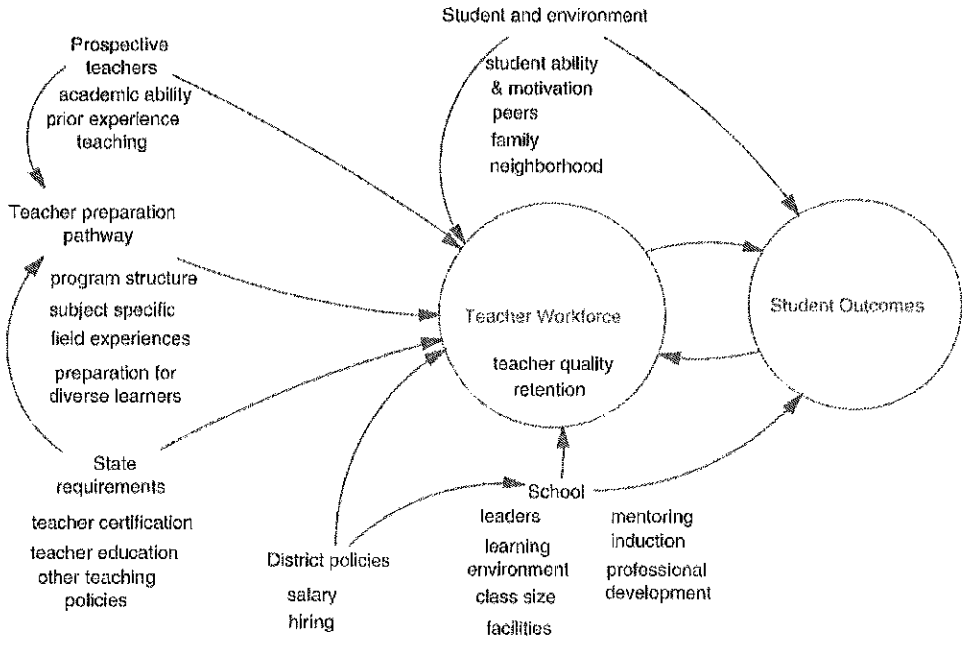
School characteristics impact teacher retention. Boyd et al. (2011) identifies a teacher's perception of her school's administration to have the greatest influence on teacher retention decisions of all other school contextual factors (i.e. teacher autonomy and ability to impact school policies, administrative support, staff relationships, student behavior and engagement, facilities, and school safety). Student characteristics can also predict teacher retention decisions. Teachers tend to move from schools with higher proportions of low-income and minority students to schools with lower proportions (Scafidi et al., 2007). Teacher attrition is higher at lower performing schools and lower at high performing schools (Boyd et al., 2005; Hanushek et al., 2001).

While many studies focus on teacher, school, and student characteristics, fewer studies focus on the educator preparation program (EPP) characteristic. Boyd et al. (2006) saw that teachers from early entry pathways such as Teach for America are more likely to leave teaching compared to teachers from traditional pathways. In contrast, Ingersoll et al. (2014) observed that the IHE, degree, pathway, and certificate have little impact on teacher retention decisions. Instead, the teaching methods, pedagogy preparation, and teaching practice are more predictive of beginning teachers choosing to stay in teaching.

This study builds upon the conceptual framework from Boyd et al. (2006), which combines the influences of teacher characteristics, school characteristics, student characteristics, and EPP characteristics. Prospective teachers enter teacher preparation programs equipped with certain abilities and experiences. Through the teacher preparation program, the teacher candidate experiences a variety of learning opportunities including field experiences, an umbrella term that encompasses student teaching. Upon completing their pathway, teachers are placed in various schools that vary in district, school administration, student characteristics, and neighborhood climate. It is important to note that selection

bias exists throughout the model: a teacher candidate's academic ability and prior teaching experience will influence her selection of an EPP, an EPP will narrow or broaden a teacher candidate's learning opportunities, and an EPP's proximity and partnership with local districts and schools affect a new teacher's school placement. Therefore, this framework does illustrate causality but the complexity of teacher outcomes.

Figure 5. A conceptual framework of the effects of teacher preparation on teacher and student outcomes



Note: The conceptual framework shows the complex relationship between teacher characteristics, teacher preparation pathway characteristics, school characteristics, the characteristics of the students and environment, teacher workforce outcomes, and student outcomes. These characteristics can also be influenced by state and district policies, as well as student outcomes. This model includes the relationship between student teaching (as a characteristic of teacher preparation pathways) and teacher retention (as one of the teacher workforce outcomes) and suggests controlling for teacher characteristic, other teacher preparation program characteristics, and school characteristics.
Source: Boyd et al. (2006, p. 159)

The framework posits teacher retention as a product of the teacher's inherent characteristics, the teacher's preparation program characteristics, and the teacher's school characteristics. Boyd et al. (2006) consider other factors including district/state requirements as well as students and their outcomes, but this study will not account for these factors due to the lack of available data and for the sake of simplifying the model. This study will focus on the relationship between field experiences (i.e. student teaching) and teacher retention. Since the impact of teacher training fades over time (Goldhaber et al., 2013), this study

will focus on retention rates of beginning teachers. Moreover, little is known about the relationship between field experiences and teacher retention. Recent work only suggests that field experiences, particularly those in congruence with the teacher's future school placement, benefit teachers adapt to classroom teaching (Boyd et al., 2008; Wilson et al., 2001).

While most studies using Texas data has focused on teacher effectiveness in improving student achievement (Rivkin et al., 2005; Hanushek et al., 2005; von Hippel et al., 2016), less attention has been given to teacher retention with the notable exception of two policy briefs. A policy brief from the University of Texas Education Research Center (Reyes and Alexander, 2015) uses TEA and Texas Higher Education Coordinating Board (THECB) data to study the influence of teacher characteristics, school characteristics, district characteristics, and EPP characteristics on teachers' three-year retention. This study, however, does not observe the influence of student teaching. A logistic regression model estimates that black and Hispanic teachers are slightly more likely to be retained compared to white teachers. Teachers at rural schools are more likely to stay compared to teachers at suburban schools, who are more likely to stay compared to teachers at charter schools.

Another policy brief from the University of Houston Center for Research, Evaluation, and Advancement of Teacher Education (Kapral and Wheatley, 2017) uses data from the U.S. Department of Education's Higher Education Act Title II Reporting System. Without controlling for other teacher or school characteristics, a logistic regression model estimates the odds of retaining a teacher with an additional one hour of required hours for student teaching is 1 times that of a teacher with one less hour of student teaching. In addition to controlling for teacher and school characteristics, this study will observe the number of required hours for student teaching in 300 hours intervals, which is approximately equivalent to one additional semester of teaching for half a day (i.e. 4 hours).

Other studies have used logistic regressions to model a teacher's retention decision. Boyd et al. (2006) uses a multinomial logistic model to represent the decision to stay at a school, move to another school, or leave the profession. However, the estimates are unpublished. Ingersoll and May (2012) also

logistic regressions to model to relationship between teacher and school characteristics on teacher turnover. The study shows that teacher salary and classroom autonomy are the strongest indicators of teacher turnover. Corresponding to previous work (von Hippel et al., 2016), this study will cluster at the highest (i.e. EPP) level to pick up correlation at both higher and lower levels.

III. Data

Data Sources

The pooled administrative data used in this study come from a variety of U.S. Department of Education and TEA maintained databases:

- TEA State Board of Educator Certification (SBEC)[3] provided records on 616,040 teacher candidates and their various certification test scores, including the pedagogy test and classroom teaching certification tests, from AY 1995-1996 to AY 2017-2018. The cross-sectional dataset of one observation includes teacher candidates' identifying and demographic data as well as an identifier for the educator preparation program that administered the certification test and test dates.
- U.S. Department of Education's Higher Education Act Title II Reporting System[3] provided records on 150[4] educator preparation programs (EPPs) from AY 2010-2011 to AY 2015-2016. Some EPPs have multiple pathways housed in the same institution. For example, Abilene Christian University possesses both a traditional pathway and an alternative (IHE-based) pathway. Because of this phenomenon, there are 225 pathways across the 150 EPPs. The panel dataset includes the average number of hours for student teaching required for each EPP with time variation. The dataset includes an identifier for the EPP, the program pathways (traditional,

[3] SBEC and PEIMS data was obtained through the University of Houston's Education Research Center (ERC). Title II and AEIS/TAPR are both publicly accessible.
[4] The number of EPPs approved by the TEA fluctuates from year to year. Emerging EPPs must meet Texas Administrative Code (TAC) standards (Rule §228) in order to become approved. TEA removes EPPs from the approved list due to closures (by under-enrollment or bankruptcy) or noncompliance.

alternative IHE-based, alternative non-IHE-based), the median GPA of accepted teacher candidates, and the percentage of minority enrollment.

- TEA Public Education Information Management System (PEIMS)[3] provided a panel database of classroom teacher's[5] school placement across 9,744 schools in Texas from AY 1995-1996 to AY 2017-2018. One-year and two-year retention data were calculated from individual teachers' changes in school placement. Classroom-level data indicates the content area, special population, and grade level the teacher teaches.
- TEA Academic Excellence Indicator System (AEIS)[3] and Texas Academic Performance Report (TAPR)[3] provided a panel database of school characteristics. AEIS contained information from AY 2003-2004 to AY 2011-2012 and TAPR contained information from AY 2012-2013 to AY 2017-2018. The dataset includes an identifier for schools, the percentage of minority students enrolled, the percentage of economically disadvantaged students enrolled, the percentage of English-language learners enrolled, beginning teacher base salary, and the student-to-teacher ratio.

Teacher characteristic data (SBEC) was merged with EPP characteristic data (Title II) by using the EPP identifier and the academic year. Since all teacher candidates in Texas are required to take a pedagogy test near the beginning of their EPP training, the academic year when the teacher candidate takes her initial pedagogy test is assumed to be the entry year of her EPP training. It is also assumed that the EPP characteristics and requirements are dependent upon a teacher candidate's entry year and cannot change over the course of her training. That is, the EPP identifier was matched with the EPP that administered the initial pedagogy test and the EPPs' academic year was matched with the academic year when the teacher candidate takes her initial pedagogy test. Teacher characteristic data (SBEC) was

[5] Classroom teachers have role code 087.

merged with school characteristic data (AEIS and TAPR) by matching the teacher candidate identifier (PEIMS) across the datasets.

Due to inconsistencies in the TEA Higher Education Act's Title II variables[6], the study was constrained to teachers who began their EPP training between AY 2011-2012 and AY 2015-2016. The study also excludes teachers who began teaching in AY 2017-2018 because 2-year retention cannot be calculated for this group without AY 2019-2020 school data. Therefore, the study sample includes complete matches of 70,852 teachers, 167 pathways across 138 EPPs, and 7,518 schools.

Variable Descriptions

The dependent variables pertain to retention. Corresponding to the discussion on retention in Section II, retention includes the situation that (1) the teacher is no longer employed as a classroom teacher at any Texas K-12 school or (2) the teacher has changed schools from the initial school placement. Retention variables are binary and measured in both one-year and two-year timeframes. That is, the teacher remained at her initial school placement to the start of her second year for one-year retention, or the teacher remained at her initial school placement to the start of her third year for two-year retention. Due to the short timeframe of available data, three-year retention will not be considered in this study. It is important to note that teachers who leave in the calculation for 1-year retention are also included in the population for the 2-year retention calculation. Additionally, while some teachers who leave the profession eventually return to teaching, they still contribute to school instability and will be considered as a teacher leaving the profession. Therefore, retention varies from teacher to teacher, but also across EPPs, schools, and time.

The independent variable is the average number of hours required for student teaching. Student teaching refers to experiences in which the teacher candidate is still enrolled in an EPP and teaches a class as the teacher of record (without faculty supervision). The independent variable refers to the number of

[6] The data from AY 2010-2011 does not include information on the median GPA of accepted teacher candidates.

student teaching hours each EPP requires and averaged across all available degree or certification plans. Other EPP- and time-variant characteristics are program tracks, the median GPA of admitted students, the percentage of black teacher candidates admitted, and the percentage of Hispanic teacher candidates admitted. The median GPA of admitted students is used as a proxy to measure an EPP's selectivity. For EPPs that accept both undergraduate and post-graduate applicants, the median GPA of admitted students is the average of the median GPA for admitted undergraduates and the median for admitted post-graduates. In the case that the EPP only accepts undergraduates or post-graduates, the median GPA of admitted students assumes the existing value. See **Table 1** for summary statistics across EPPs.

The following school characteristics vary by school and by time: average classroom student-teacher ratio, the average base salary of a beginning teacher, the percentage of black students enrolled, the percentage of Hispanic students enrolled, the percentage of economically disadvantaged students enrolled, and the percentage of English-language learners enrolled. The average classroom student-teacher ratio is the number of students to each teacher and averaged across all classrooms within a school. The average base salary of a beginning teacher is the salary a first-time teacher receives before bonuses and averaged across all first-time teachers within a school.

This study also controls for teacher characteristics. These characteristics include each teacher's initial pedagogy test score, her gender, and her race/ethnicity. The initial pedagogy test score is used as a proxy to measure the teacher's aptitude for teaching since it is required of all teachers regardless of their subject area. **Table 2** depicts the summary statistics across the teacher population.

Table 1

Summary statistics of educator preparation programs (EPPs), AY 2011-12 to AY 2015-16

	Overall (Obs = 925)		Traditional/Alt. (IHE-based) (Obs = 636)[a]		Alternative (non-IHE-based) (Obs = 289)[a]	
Variable	Mean	Standard Dev.	Mean	Standard Dev.	Mean	Standard Dev.
Educator Preparation Program (EPP) Characteristics						
Average Number of Hours Required for Student Teaching	613.355	346.118	589.827	254.079	665.135	487.955
Program Pathway						
Traditional	0.392	0.489	0.571	0.495	N/A	N/A
Alternative (IHE-based)	0.295	0.456	0.429	0.495	N/A	N/A
Alternative (non-IHE-based)	0.312	0.464	N/A	N/A	1	0
Median GPA of Admitted Students	3.020	0.560	3.047	0.543	2.962	0.592
Percentage of Black Candidates Admitted	0.136	0.195	0.135	0.213	0.139	0.149
Percentage of Hispanic Candidates Admitted	0.323	0.283	0.288	0.261	0.400	0.313

Note: The table above reports the summary statistics of educator preparation programs (EPPs) for relevant EPP characteristics. The first two columns are the means and standard deviations of all EPPs. The middle two columns are the means and standard deviations of traditional and alternative, IHE-based EPPs. These two pathways are grouped together because they typically have similar characteristics. The last two columns are the means and standard deviations of alternative, non-IHE-based EPPs.

Table 2

Summary statistics of teacher population, AY 2011-12 to AY 2015-16

	Overall (Obs = 70,852)		Traditional/Alt. (IHE-based) (Obs = 30,710)		Alternative (non-IHE-based) (Obs = 40,142)	
Variable	Mean	Standard Dev.	Mean	Standard Dev.	Mean	Standard Dev.
Retention Rate						
Within 1 Year	0.747	0.435	0.751	0.432	0.744	0.436
Within 2 Years	0.552	0.497	0.556	0.494	0.533	0.499
Educator Preparation Program (EPP) Characteristics						
Average Number of Hours Required for Student Teaching	591.058	291.058	572.161	179.012	605.515	354.254
Program Pathway						
Traditional	0.412	0.492	0.950	0.218	N/A	N/A
Alternative (IHE-based)	0.022	0.146	0.050	0.218	N/A	N/A

Alternative (non-IHE-based)	0.567	0.496	N/A	N/A	1	0
Median GPA of Admitted Students	3.049	0.245	3.085	0.298	3.022	0.189
Percentage of Black Candidates Admitted	0.135	0.117	0.068	0.096	0.186	0.104
Percentage of Hispanic Candidates Admitted	0.273	0.218	0.293	0.235	0.258	0.203
School Characteristics						
Average Classroom Student-Teacher Ratio	15.346	2.610	15.260	2.505	15.411	2.686
Average Base Salary of Beginning Teacher	45141.86	7151.091	44970.95	7805.928	45272.61	6603.554
Percentage of Black Students Enrolled	15.169	17.221	13.333	15.177	16.574	18.511
Percentage of Hispanic Students Enrolled	55.725	28.108	53.807	27.692	57.192	28.336
Percentage of Economically Disadvantaged Students Enrolled	65.835	24.731	63.294	25.087	67.779	24.277
Percentage of English-Language Learners Enrolled	19.660	19.249	19.341	19.063	19.904	19.386
Teacher Characteristics						
Initial Pedagogy Test Score	265.295	14.996	265.140	14.373	265.413	15.454
Females	0.737	0.441	0.811	0.392	0.680	0.467
Race/Ethnicity						
White	0.553	0.497	0.597	0.490	0.520	0.500
Black	0.123	0.328	0.064	0.244	0.168	0.374
Hispanic	0.281	0.450	0.299	0.458	0.267	0.442
Other	0.043	0.203	0.040	0.195	0.045	0.208

Note: The table above reports the summary statistics of teacher characteristics for relevant EPP, school, and teacher characteristics. The first two columns are the means and standard deviations of all EPPs. The middle two columns are the means and standard deviations of traditional and alternative, IHE-based EPPs. These two pathways are grouped together because they typically have similar characteristics. The last two columns are the means and standard deviations of alternative, non-IHE-based EPPs.

IV. Methods

First, the study uses the following model is used to estimate the association between educator preparation program (EPP) characteristics and the number of hours required for student teaching:

$$StuTeach_{pt} = Pathway_p + GPA_{pt} + PercentBlack_{pt} + PercentHispanic_{pt} + u_t + \varepsilon$$

This model represents the number of student teaching hours required by an EPP $\boldsymbol{p}$ as a linear function of other EPP characteristics—program pathway, median GPA of accepted teacher candidates, and percentage of black or Hispanic teacher candidates enrolled. All characteristics but program pathway are time $\boldsymbol{t}$ varying characteristics. The model includes year fixed effects and clusters standard errors $\boldsymbol{\varepsilon}$ by EPP. Notably, the average alternative pathway requires more hours of student teaching compared to traditional pathways (see **Figure 4** and **Table 3**). Programs that admit teacher candidates with higher GPAs also, on average, require more hours of student teaching. Although not included here, a possible omitted variables is the amount of time the EPP devotes to pedagogy, or learning how to teach, which typically reduces the amount of time spent practicing teaching.

Table 3. Associations between educator preparation program (EPP) characteristics and average number of hours required for student teaching

	OLS Regression with Year FE
Variable	$\hat{\beta}$ (se)
Program Pathway	
Traditional	0.000
	(.)
Alternative (IHE-based)	114.621**
	(40.973)
Alternative (non-IHE-based)	129.1823*
	(58.423)
Median GPA of Admitted Students	48.470*
	(20.972)
Percentage of Black Candidates Admitted	80.262
	(94.814)
Percentage of Hispanic Candidates Admitted	-4.801

	(82.740)
r2	0.04
N	925

Note: The table above reports the estimated relationship between key educator preparation program (EPP) characteristics and the average number of hours required for student teaching, using an OLS regression with year fixed effects. Significance levels are indicated by *, **, *** for 10%, 5%, and 1% respectively.

The following model is used to estimate the association between student teaching and teacher retention rates:

$$Retention_{ipst} = \beta_0 + \beta_1 StuTeach_{pt} + \beta_2 EPP_{pt} + \beta_3 School_{st} + \beta_4 Teacher_{it} + u_p + u_t + \varepsilon_{ipst}$$

Here the likelihood of one- or two-year retention of teacher ***i*** is a linear function of time **t** varying characteristics of field experiences, EPPs, and schools. As in the previous model, the student teaching characteristics is the number of hours required student teaching hours, which also varies by EPP ***p***. The vector of teacher preparation programs' characteristics includes program pathway, median GPA of accepted teacher candidates, and percentage of black or Hispanic teacher candidates enrolled. The vector of school ***s*** characteristics includes the student-teacher ratio, the average base salary for beginning teachers, the percentage of student minority enrollment, the percentage of economically disadvantaged students enrolled, the percentage of English-language learners enrolled. The vector of teacher characteristics includes demographics and the teacher's initial pedagogy test scores. The model also includes EPP fixed effects u_p, year fixed effects u_t, and a standard error term ε that is clustered by EPP.

The variable for retention is binary such that 0 signifies a teacher's decision to leave and 1 signifies a teacher's decision to stay. The average number of hours required for student teaching is divided into intervals to aid in the interpretation of the model. Each interval represents one additional semester of student teaching for half-days. This is equivalent to 300 hours per semester or 4 hours per day, 5 days per week, and 15 weeks per semester (see **Table 3**). Median GPA of admitted students was also divided into quartiles but did not aid in the interpretation of the model and was removed. Logarithm of average base salary of beginning teachers is also used in the model.

Table 3. Summary statistics of the average number of hours required for student teaching by number of semesters

Variable	Obs.	Mean	Standard Dev.	Min	Max
1 Semester (0-300 Hours)	70,852	0.055	0.228	0	1
2 Semesters (301-600 Hours)	70,852	0.755	0.430	0	1
3 Semesters (601-900 Hours)	70,852	0.077	0.267	0	1
4 Semesters (901-1200 Hours)	70,852	0.021	0.142	0	1
5 Semesters (1201-1500 Hours)	70,852	0.079	0.270	0	1
6 Semesters (1501-1800 Hours)	70,852	0.013	0.111	0	1

Note: The table above reports the six intervals created for the average number of hours required for student teaching. Each interval has a range of 300 hours, which reflects the number of hours typically earned from one semester of student teaching for 4 hours per day. Most educator preparation programs require two semesters, or between 301-600 hours, of student teaching.

This study uses several alternative specifications to estimate the relationship between student teaching and teacher retention. Specification (1) is an OLS regression with year and EPP fixed effects while clustering standard errors by EPP. In addition to natural year-to-year changes among EPPs and schools such as demographic changes, the SBEC also issued various changes to EPPs between 2011 and 2016. For example, in 2013, Texas EPPs could not require a minimum GPA higher than 2.75[7] for admissions, which was later reduced to 2.5 in 2015[8]. Year fixed effects would capture these changes as well. The EPP fixed effects absorbs any uniqueness of an EPP that impacts teacher retention and is not explained by the vector of EPP characteristics such as pedagogy instruction. School fixed effects is not used in this study, because the multitude of schools causes school fixed effects to soak up all variation in teacher retention. The clustering of standard errors by EPP accounts for the correlation among teachers certified by the same EPP. Specification (2) is a logistic regression with some combination of time fixed effects, EPP fixed effects, clustering standard errors by EPP. These specifications convert the log-odds of a teacher staying or leaving to a probability.

[7] 83rd Texas Legislature, Regular Session, House Bill 2012
[8] 84th Texas Legislature, Regular Session, House Bill 2205

Table 5

Associations between student teaching and one-year retention

Variable	(1) OLS Regression with Year & EPP FE $\hat{\beta}$ (se)	(2) Logit Regression with Year & EPP FE $\hat{\beta}$ (se)
Number of Hours Required for Student Teaching		
1 Semester (0-300 Hours)	0.000	0.000
	(.)	(.)
2 Semesters (301-600 Hours)	0.084**	1.544**
	(0.029)	(0.205)
3 Semester (601-900 Hours)	0.113***	1.820***
	(0.033)	(0.284)
4 Semesters (901-1200 Hours)	0.107*	1.766*
	(0.048)	(0.471)
5 Semesters (1201-1500 Hours)	0.105***	1.733***
	(0.031)	(0.254)
6 Semesters (1501-1800 Hours)	0.144*	2.085*
	(0.064)	(0.732)
Program Pathway		
Traditional	0.000	0.000
	(.)	(.)
Alternative (IHE-based)	-0.001	0.986
	(0.022)	(0.115)
Alternative (non-IHE-based)	0.034	1.414
	(0.045)	(0.349)
Median GPA of Admitted Students	0.031**	1.178**
	(0.011)	(0.070)
Percentage of Black Candidates Admitted	0.005	1.003
	(0.060)	(0.352)
Percentage of Hispanic Candidates Admitted	0.061	1.429
	(0.041)	(0.327)
Average Classroom Student-Teacher Ratio	0.003***	1.016***
	(0.001)	(0.004)
Logarithm of Average Base Salary of Beginning Teacher	0.192***	2.705***
	(0.017)	(0.254)
Percentage of Black Students Enrolled	-0.001***	0.996***
	(0.000)	(0.001)
Percentage of Hispanic Students Enrolled	0.000	1.002
	(0.000)	(0.001)
Percentage of Economically Disadvantaged Students Enrolled	-0.002***	0.990***
	(0.000)	(0.001)
Percentage of English-Language Learners Enrolled	0.001***	1.003***

	(0.000)	(0.001)
Initial Pedagogy Test Score	0.000*	1.002*
	(0.000)	(0.001)
Female	0.024***	1.139***
	(0.004)	(0.024)
Race/Ethnicity		
White	0.000	0.000
	(.)	(.)
Black	0.043***	1.256***
	(0.005)	(0.037)
Hispanic	0.043***	1.264***
	(0.006)	(0.045)
Other	-0.008	0.955
	(0.009)	(0.042)
r2	0.027	
N	70852	70847

Note: The table above reports the estimated impact of the average number of hours required for student teaching on a teacher's one-year retention rate and controlling for educator preparation program (EPP), school, and teacher characteristics. 1 Semester (0-300 Hours) of student teaching hours is used as the reference category. The first column consists of the estimated coefficients of the OLS regression with year and EPP fixed effects. The second column consists of the estimated coefficients of the logistic regression with year and EPP fixed effects. Significance levels are indicated by *, **, *** for 10%, 5%, and 1% respectively.

Table 6

Associations between student teaching and two-year retention

Variable	(1) OLS Regression with Year & EPP FE $\hat{\beta}$ (se)	(2) Logit Regression with Year & EPP FE $\hat{\beta}$ (se)
Number of Hours Required for Student Teaching		
1 Semester (0-300 Hours)	0.000	0.000
	(.)	(.)
2 Semesters (301-600 Hours)	0.046**	1.218**
	(0.018)	(0.092)
3 Semester (601-900 Hours)	0.032	1.148
	(0.020)	(0.099)
4 Semesters (901-1200 Hours)	0.121**	1.709**
	(0.038)	(0.313)
5 Semesters (1201-1500 Hours)	0.039**	1.176**
	(0.015)	(0.074)
6 Semesters (1501-1800 Hours)	-0.061	0.775
	(0.054)	(0.165)
Program Pathway		
Traditional	0.000	0.000
	(.)	(.)
Alternative (IHE-based)	-0.015	0.94

	(0.026)	(0.105)
Alternative (non-IHE-based)	0.108*	1.860***
	(0.044)	(0.343)
Median GPA of Admitted Students	0.001	1.004**
	(0.016)	(0.066)
Percentage of Black Candidates Admitted	-0.06	0.784
	(0.070)	(0.225)
Percentage of Hispanic Candidates Admitted	0.066	1.332
	(0.037)	(0.204)
Average Classroom Student-Teacher Ratio	0.003*	1.010*
	(0.001)	(0.004)
Logarithm of Average Base Salary of Beginning Teacher	0.257***	3.375***
	(0.021)	(0.351)
Percentage of Black Students Enrolled	-0.001***	0.994***
	(0.000)	(0.001)
Percentage of Hispanic Students Enrolled	0.001	0.994
	(0.000)	(0.001)
Percentage of Economically Disadvantaged Students Enrolled	-0.003***	1.002***
	(0.000)	(0.001)
Percentage of English-Language Learners Enrolled	0.001**	1.002**
	(0.000)	(0.001)
Initial Pedagogy Test Score	-0.000	1.000
	(0.000)	(0.001)
Female	0.021***	1.094***
	(0.004)	(0.020)
Race/Ethnicity		
White	0.000	0.000
	(.)	(.)
Black	0.072***	1.350***
	(0.006)	(0.034)
Hispanic	0.076***	1.377***
	(0.009)	(0.055)
Other	-0.008	0.965
	(0.008)	(0.035)
r2	0.041	
N	70852	70846

Note: The table above reports the estimated impact of the average number of hours required for student teaching on a teacher's two-year retention rate and controlling for educator preparation program (EPP), school, and teacher characteristics. 1 Semester (0-300 Hours) of student teaching hours is used as the reference category. The first column consists of the estimated coefficients of the OLS regression with year and EPP fixed effects. The second column consists of the estimated coefficients of the logistic regression with year and EPP fixed effects. Significance levels are indicated by *, **, *** for 10%, 5%, and 1% respectively.

V. Results

Estimating the Model for One-Year Retention

All quartiles of the average number of hours required for student teaching are statistically significant under specification (1) and (2), which controls for both year and educator preparation program (EPP) fixed effects. By controlling for year and EPP fixed effects, the following results are not driven by just differences over years or across EPPs. For specification (1), increasing the number of student teaching hours from one semester (0-300 hours) to two semesters (301-600 hours) increases the likelihood of retaining a teacher for one-year by 0.084. Increasing it to three semesters (601-900 hours) increases the likelihood by 0.113, 0.107 for four semesters, 0.105 for five semesters, and 0.144 for six semesters. For specification (2), increasing the number of student teaching hours from one semester to two semesters increases the odds of retaining a teacher for one-year by 54.4 percent. Increasing it to three semesters increases the odds by 82 percent, 76.6 percent for four semesters, 73.3 percent for five semesters, and 108.5 percent for six semesters. However, by F-testing, the second, third, fourth, fifth, and sixth semesters are not statistically different from one another. That is, the only statistically different coefficient is the difference between one and two semesters of student teaching.

The coefficient for alternative pathways based in institutions of higher education (IHE) is neither statistically significant nor economically meaningful for specification (1) and (2). Although the coefficients for alternative, non-IHE-based pathways are not statistically significant, they suggest that being trained by an alternative, non-IHE-based pathway increases the likelihood and odds of retaining teacher for one year. In contrast—although statistically significant—increases in median GPA of admitted teacher candidates correlate with only slight increases in the likelihood and odds of teacher one-year retention. In specification (1), a 1 standard deviation change in median GPA correlates with a 0.0003 increase in the likelihood of a teacher's one-year retention. In specification (2), a 2 standard deviation change in median GPA correlates with a 1.246 percent increase in the odds of retaining a teacher for one year. The coefficient for the percentage of black teacher candidates admitted is neither statistically

significant nor economically meaningful. The coefficient for the percentage of Hispanic teacher candidates admitted, although not statistically significant, suggest that a higher percentage is correlated with higher likelihood and odds of one-year teacher retention.

Many of the coefficients for school characteristics, while statistically significant, is not economically meaningful. Specification (1) of the student-teacher ratio suggests that a 1 standard deviation change in the ratio is correlated with a 0.000003 increase in the likelihood of a teacher's one-year retention. Specification (2) suggests that a 1 standard deviation change in the ratio is correlated with a 0.0064 percent increase in the odds of retaining a teacher for one year. Similarly, the average base salary of a beginning teacher is statistically significant but not economically meaningful. In specification (1), a 1 percent increase in the base salary is correlated with a 0.00192 increase in the likelihood of one-year teacher retention. In specification (2), a 1 percent increase in the base salary is correlated with a 1.705 percent increase in the odds of one-year teacher retention. A lack of economic meaning is true for the percentage of black students enrolled, the percentage of economically disadvantaged students enrolled, and the percentage of English-language learners enrolled. The percentage of Hispanic students enrolled is neither statistically significant nor economically meaningful.

As with the school characteristics, the coefficient for a teacher's initial pedagogy test score is statistically significant but not economically meaningful. The coefficients for whether a teacher is female, black, or Hispanic are both statistically significant and economically meaningful. The female coefficient, in specification (1), suggests that a female teacher is 0.024 more likely to be retained compared to a male teacher. In specification (2), the odds of retaining a female teacher is 13.9 percent more than that of a male teacher. Compared to a white teacher, a black teacher is 0.043 more likely to be retained based on specification (1). The odds of retaining a black teacher is 25.6 percent more than that of retaining a white teacher.

Estimating the Model for Two-Year Retention

All the coefficients for the number of hours required for student teaching suggests that more student teaching correlates with increases in the likelihood and odds of two-year teacher retention. The only exception is the coefficient for six semesters, which suggests a negative correlation. In specification (1), increasing the number of hours required for student teaching from one to two semesters correlates with a 0.046 increase in the likelihood of retaining a teacher for two years, or a 21.8 percent increase in the odds of retaining a teacher for two years as in specification (2). While the coefficient for three semesters is not statistically significant, it is positively correlated with the likelihood and odds of two-year teacher retention. In specification (1), the increase from one semester to four semesters of student teaching is correlated with a 0.121 increase in the likelihood of retaining a teacher for two years. In specification (2), the increase from one to four semesters is correlated with a 70.9 percent increase in the odds of retaining a teacher for two years. The increase from one to five semesters is correlated with a 0.039 increase in the likelihood of retaining a teacher for two years, by specification (1), and a 17.6 percent increase in the odds of retaining a teacher for two years, by specification (2). By F-testing, the first and second semester are statistically significantly different from one another. The third and fourth semesters, the fourth and fifth semesters, and the fifth and sixth semesters are also statistically significantly different from one another, although at a lower (5 percent) confidence level.

The coefficient for alternative, IHE-based pathways are neither statistically significant nor very economically meaningful. The coefficient for alternative, non-IHE pathways are statistically significant and economically meaningful. In specification (1), compared to a traditionally trained teacher, an alternatively trained teacher at a non-IHE has a 0.108 higher likelihood of being retained. In specification (2), the alternatively trained teacher has 86 percent higher odds of being retained. The coefficient for median GPA of admitted students is not economically meaningful. Neither the coefficients for the percentage of black teacher candidates nor the coefficient for the percentage of Hispanic teacher candidates is statistically significant. However, the coefficient suggests that teachers trained at EPPs with

higher percentages of black teacher candidates admitted are less likely to be retained within two years. The other coefficient suggests that teachers trained at EPPs with higher percentages of Hispanic teacher candidates admitted are more likely to be retained within two years.

Although the coefficient for the average student-teacher ratio, the average base salary for beginning teachers, the percentage of black students enrolled, the percentage of economically disadvantaged students, and the percentage of English-language learners enrolled are statistically significant, none of them are economically meaningful. The percentage of Hispanic students enrolled is neither statistically significant nor economically meaningful.

Of the coefficients for teacher characteristics, only the coefficients for female teachers, black teachers, and Hispanic teachers are statistically significant and economically meaningful. In specification (1), a female teacher is 0.021 more likely to be retained for two years compared to a male teacher. In specification (2), a female teacher has 9.4 percent higher odds of two-year retention compared to a male teacher. In specification (1), a black teacher is 0.072 more likely to be retained for two years and a Hispanic teacher is 0.076 more likely compared to a white teacher. In specification (2), a black teacher has 35 percent higher odds of two-year retention and a Hispanic teacher has 37.7 percent higher odds compared to a white teacher.

Now, this study assumes that all 70,852 teachers in the sample population receives the same amount of student teaching hours to predict one-year and two-year retention rates. For one-year retention rates, the change from one semester to two semesters of student teaching yields the largest gains, from a 65.8 percent to a 74.6 percent retention rate. For two-year retention rates, the change from three semesters to four semesters of student teaching yields the largest gains, from a 54.2 percent to a 63.4 percent retention rate. Both predicted one-year retention rates appear to exhibit decreasing marginal returns (see **Table 7, Table 8, Figure 7,** and **Figure 8**). It is important to note that the sixth semester is likely biased due to a small sample size (see **Table 3**).

Table 7. Predicting one-year retention rates

Variable	Obs.	Mean	Std. Dev.	Min	Max
1 Semester (0-300 Hours)	70,852	0.658	0.087	0.002	0.958
2 Semesters (301-600 Hours)	70,852	0.746	0.074	0.003	0.972
3 Semesters (601-900 Hours)	70,852	0.775	0.069	0.004	0.976
4 Semesters (901-1200 Hours)	70,852	0.770	0.070	0.004	0.976
5 Semesters (1201-1500 Hours)	70,852	0.766	0.071	0.004	0.975
6 Semesters (1501-1800 Hours)	70,852	0.797	0.064	0.004	0.979

Table 8. Predicting two-year retention rates

Variable	Obs.	Mean	Std. Dev.	Min	Max
1 Semester (0-300 Hours)	70,852	0.509	0.103	0.000	0.943
2 Semesters (301-600 Hours)	70,852	0.556	0.103	0.000	0.953
3 Semesters (601-900 Hours)	70,852	0.542	0.103	0.000	0.950
4 Semesters (901-1200 Hours)	70,852	0.634	0.098	0.000	0.967
5 Semesters (1201-1500 Hours)	70,852	0.547	0.103	0.000	0.951
6 Semesters (1501-1800 Hours)	70,852	0.448	0.102	0.000	0.928

Note: The tables above predict the 1-year and 2-year, respectively, retention rates of the teacher population given all observations in the dataset assumes the value of a select semester. For example, the first row of each table assumes that all 70,852 teachers in the population have one semester or 0-300 hours of student teaching. As a result, the 65.8 percent of teachers will be retained within one year and 50.9 percent of teachers will be retained within two years.

Figure 7. Predicting one-year retention rates

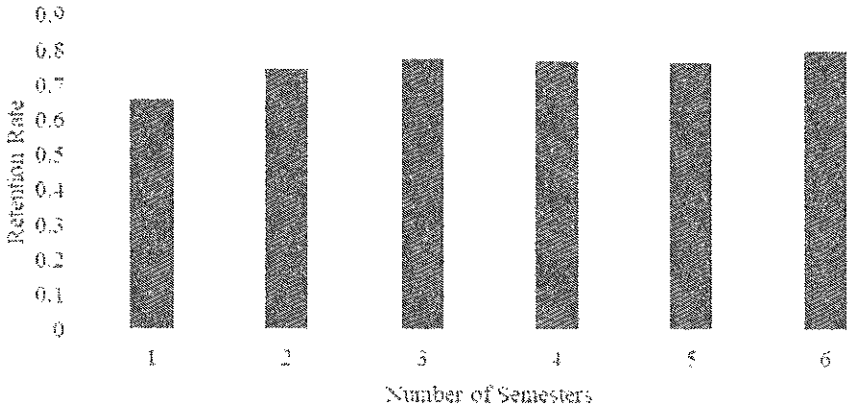
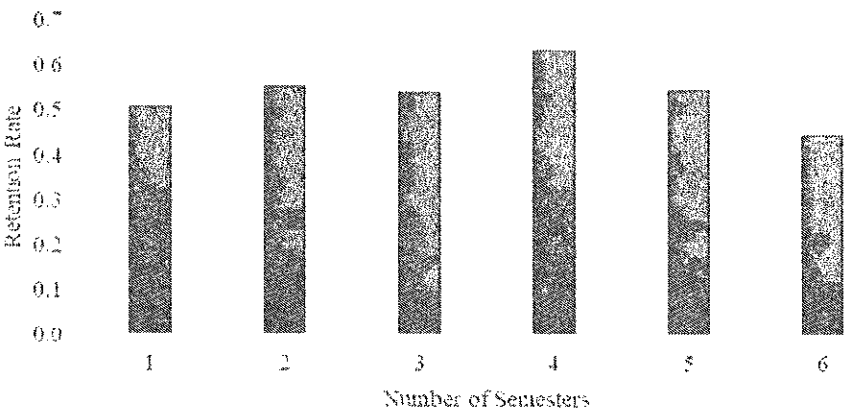


Table 8. Predicting one-year retention rates



Note: The tables above predict the 1-year and 2-year, respectively, retention rates of the teacher population given all observations in the dataset assumes the value of a select semester. For example, the first row of each table assumes that all 70,852 teachers in the population have one semester or 0-300 hours of student teaching. As a result, the 65.8 percent of teachers will be retained within one year and 50.9 percent of teachers will be retained within two years.

VI. Discussion

The results suggest that more hours required for student teaching, compared to little or no student teaching, correlates with overall higher odds of teacher retention. This corresponds with the theory that teachers do benefit from more teaching practice (Ingersoll et al., 2014; Levine, 2006). The large gains from increasing student teaching hours contradicts Kapral and Wheatley (2017) which suggests only small gains in teacher retention. However, Kapral and Wheatley (2017) only considered the impact of EPP characteristics without controlling for school or teacher characteristics. Moreover, prediction analysis and F-testing indicates that there are diminishing marginal returns to student teaching. Later additional hours of student teaching yield less explanatory power on retention rates compared to earlier hours. It is also possible that student teaching beyond the two or three semesters could yield benefits in other terms, such as student outcomes.

Alternative pathways are often positively correlated with teacher retention, putting this study in disagreement with Boyd et al. (2006). Although not always statistically significant, the coefficient for alternative pathways suggest the odds of retaining an alternatively certified teacher are significantly different than the odds of retaining a traditionally certified teacher, contradicting Ingersoll et al. (2014).

Like Kapral and Wheatley (2017), Ingersoll et al. (2014) did not control for both school and teacher characteristics. A positive coefficient goes against the notion that there exists a selection bias—traditionally certified teachers are more likely to want to be teachers compared to alternatively certified teachers who might have chosen to become teachers after a career change. However, surveys have also shown this to be too general to describe both the alternatively certified and traditionally certified teacher population.

Other notable findings include a higher average median GPA of accepted students correlates with marginally higher odds of retaining the teacher, at least for one-year retention. This does not align with Boyd et al. (2005); more qualified teachers are more likely to leave teaching. Although the percentage of Hispanic enrollment in EPPs and a teacher's race/ethnicity are significant in this study, their meaning is unclear. As Reyes and Alexander (2015) suggests, these two variables could be proxies for a teachers' preparation for working with a student population that is majority minority. Although salary has a slight positive correlation to teacher retention it is not to the degree suggested by Ingersoll and May (2012). As before, Ingersoll and May (2012) did not control for both school and teacher characteristics.

There are some limitations to this study. Our study was limited to a fairly short time frame, which reduced variation in the number of required hours for student teaching. Due to the size of our dataset, it was not possible to include school fixed effects which would account for within-school differences. In addition, many educator preparation programs (EPPs) produced too few teachers thus causing the clustered standard errors to likely be biased and volatile (von Hippel et al., 2016). In addition, the number of student teaching hours does not capture the quality of the student teaching experience. For example, Wilson et al. (2001) suggests that field experiences are beneficial when they match a teacher's future placement, which is not included in this study. Also not included in this study is the timing of the student teaching experience with respect to the teachers' pedagogy and subject matter training. Including these variables would likely increase the explanatory power of field experiences and student teaching.

More recent Texas policy changes reflect a focus on the number of hours required for field experiences and student teaching. By statute, all EPPs required at least 30 hours of field experiences in 2008. In 2011, a teacher must complete 15 hours of field experiences before she can be employed by a school district, which increased to 30 hours of field experiences by 2014. In 2018, an average of four hours per day of was required for teaching practice in subject area and grade level. However, this study suggests that there are large gains to increasing the number of hours required for student teaching. Overall, the state should require two to three semesters of student teaching, which yields the highest benefits in terms of teacher retention. The state should also focus on regulating and collecting data on the quality of student teaching experiences. Future studies should include more parameters for student teaching.

VII. Conclusions

Teacher surveys often cite student teaching experiences as one of the most impactful aspects of a teacher's preparation (Levine, 2006). Previous studies (Ingersoll et al., 2014) also suggest that field experiences, particularly those corresponding to a teacher's future placement, are beneficial to teachers. Likewise, this study suggests that increasing the number of required hours for student teaching correlates with substantial gains in the odds of retaining a teacher. In fact, increasing the number of hours required for student teaching from one semester (0-300 hours) to two semesters (301-600 hours) can increase the odds of one-year retention by 54.4 percent. Increasing the number of hours required for student teaching from one semester (0-300 hours) to three semesters (601-900 hours) can increase the odds of two-year retention by 14.8 percent. However, these calculations do not consider the quality of student teaching experiences. Therefore, state policies should share focus on regulating and collecting data on the quality of student teaching experiences.

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