Teacher attrition in the midst of geographical, societal, and economic realities: Insights from fifteen years of the Kansas teacher workforce

by

Chanh Bao Lam

B.S., Ho Chi Minh City University of Education, 2018
M.S., Kansas State University, 2021

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Curriculum and Instruction
College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

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Abstract

Leveraging longitudinal administrative data from Kansas, a state with a unique mixture of urban and rural dynamics, I examine mobility patterns of the state's public-school teachers from 2010 through 2024. I find teacher attrition has sharply increased since the COVID-19 pandemic, especially by those who resigned from the state's public elementary and secondary school system (i.e., leavers). I also find teachers employed in city schools are more likely to depart from the state's school system relative to their colleagues in suburban and rural/town schools, even after accounting for the relative urbanicity of the district's local community. Moreover, teachers serving the most marginalized and impoverished students are at the highest risks of turning over. Furthermore, STEM and SPED/ESOL teachers are significantly more likely to turn over relative to their counterparts in other subject categories. Notably, while salary and benefits are significantly associated with reductions in teacher turnover across teaching disciplines, the relationship is most pronounced among STEM and SPED/ESOL educators. These findings reflect the complex geographical, societal, and economic circumstances of Kansas, offering critical insights to targeted policy considerations for addressing the state's teacher staffing challenges. I discuss the needs for Kansas to diversify its teacher workforce, addressing potential disparities among teacher working conditions, including among schools within the same district, as well as the potential of differential pay policies for Kansas educators amid the state's chronic teacher shortages and changing labor markets in the post-COVID-19 era.

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List of Abbreviations

CADD: Computer-Aided Design and Drafting

CARR: Community Assets and Relative Rurality

CCD: Common Core Data

CTE: Career and Technical Education

ESOL: English for Speakers of Other Languages

FTE: Full-Time or Equivalent

FRPL: Free- or Reduced-Price Lunch

GSHI: School's Highest Grade Offered

GSLO: School's Lowest Grade Offered

KSDE: Kansas State Department of Education

LPI: Learning Policy Institute

NCES: National Center for Education Statistics

PK: Pre-Kindergarten

ROTC: Reserve Officers' Training Corps

SPED: Special Education

STEM: Science, Technology, Engineering, and Mathematics

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Dedication

Dành cho má của con

Chapter 1 - Introduction

In September, 2016, a report by the Learning Policy Institute (LPI) ignited a crisis-level concern about teacher shortages across the United States (Sutcher et al., 2016). Although the LPI's estimate of the shortage magnitude was debatable (e.g., García & Weiss, 2019b; Goldhaber & Theobald, 2016; Nguyen et al., 2022), it was undeniable that schools across the U.S. were unable to sufficiently staff their classrooms. Since the LPI report, teacher shortages have continued to made headlines across media outlets (Chen & Murphy, 2022; James, 2021; Lee, 2022; Postal, 2023; Rutz, 2022; Whitney, 2023), while state education agencies, research institutions, and the media have collectively documented over 39,000 vacant teacher positions across the country by the end of the 2021-2022 school year (Nguyen et al., 2024). This is yet an underestimate, as many states underreported their vacancies, and such information was not available for every state (Franco & Patrick, 2023; Nguyen et al., 2022, 2024; Tan et al., 2024).

Challenges of the U.S. teacher workforce are not only about vacant positions (Dee & Goldhaber, 2017; Sutcher et al., 2019), but also that teachers have been resigning at alarming rates (Darling-Hammond, 2010; Goldhaber & Theobald, 2023). The most recent data show substantially high levels of annual teacher attrition across U.S. states, with a national average of about 15% (Nguyen, 2021), while many states experience from 17 to over 22% annual turnover, such as the District of Columbia, Colorado, Alaska, Kentucky, and Washington (Goldhaber & Theobald, 2023; *Teacher Shortages in the United States*, n.d.). Such high attrition challenges schools to maintain sufficient staff levels, which is especially difficult amid shortages.

Moreover, high degrees of teacher attrition disrupt student learning and school stability. High attrition rates reduce achievement levels of not only the students of the teachers who resign, but also the students of their colleagues due to losses in school's relational trust, professional and

institutional knowledge, in addition to the increased workload for the remaining teachers (Ronfeldt et al., 2013). These detriments persist even when accounting for teacher effectiveness and/or time of leaving (Hanushek et al., 2016; Henry & Redding, 2020). Furthermore, teacher attrition leads to costly interventions at the school level such as increasing class size, lengthening teacher work hours, and beyond the school including accelerated teacher education programs and loosened teacher qualification requirements (Sorensen & Ladd, 2020). Especially concerning is teacher attrition and the challenges associated with it have been maldistributed among schools, with the greatest impacts on schools serving primarily students of colors, low-income families, as well as highly rural and urban communities (Darling-Hammond, 2010; Nguyen, 2020a; Sorensen & Ladd, 2020).

Teacher attrition is associated with a variety of factors, ranging from demographic, professional, organizational, as well as social and political circumstances (Nguyen & Springer, 2023; Odell & Ferraro, 1992). Research during the period 1980-2005 found race, gender, and age associated with teacher turnover; so were preparation pathways, teaching experience, graduate degrees; as well as salary, administrative support, colleague support and collaboration, and employment in schools serving high percent of students of color and poverty (Borman & Dowling, 2008). More recent studies, however, found women and teachers with graduate degrees were not more likely to depart than men or teachers without a graduate degree; the updated literature also added a host of policy and labor market factors to the picture, including teacher evaluation, retention bonuses, merit pay, and local employment rates (Nguyen et al., 2020). Furthermore, there has been evidence of differentiated relationships between the varied factors and teacher attrition, including salary and teachers' stage of career (Borman & Dowling, 2008); teacher-principal gender congruence (Grissom et al., 2012), teacher-principal race matches

(Bartanen & Grissom, 2019), teacher demographics and school locales (Nguyen, 2020a), certification areas and school organizational characteristics (Guthery & Bailes, 2022), teacher effectiveness and evaluation procedure (Rodriguez et al., 2020), as well as various levels of alignment between the teacher and the school (e.g., aligned goals, values, and professional preferences) (Miller et al., 2020).

Collectively, the research literature suggests teacher attrition is complex, and there exist substantial variations among local contexts (Nguyen, 2020a; Nguyen et al., 2020). However, many studies in this set of literature drew insights from cross-sectional data collected at the national level, such as the National Teacher and Principal Survey (NTPS), formerly the Schools and Staffing Survey (SASS) (Ingersoll & May, 2012; Nguyen, 2021; Viano et al., 2023), which has been administered once every few years over the past decades. These data are rich and informative but fall short of capturing the annual intricacy needed to observe how teacher attrition has changed over time, especially over the COVID-19 pandemic, while not fully reflect the variation in teacher attrition among regions, districts, and schools within individual states.

Meanwhile, studies that leveraged state-level longitudinal data have been predominantly conducted for states with long standing research databases and resources, such as California, New York, Texas, or Washington (Darling-Hammond et al., 2016; Goldhaber & Theobald, 2023; Holme et al., 2018; Ronfeldt et al., 2013), while there is limited information about Midwestern states, including Kansas (Nguyen, 2020b). In fact, Kansas has been facing chronic teacher staffing challenges (Kansas State Department of Education, 2016, 2019, 2022). Kansas also differs in several ways relative to the abovementioned states with extensive teacher attrition research. In particular, Kansas has some of the most geographically isolated regions in the U.S. (Nguyen, 2020b), alongside several of the nation's historically industrialized, metropolitan areas,

such as Wichita, Topeka, and Kansas City. The socioeconomic and political landscapes of the state, with its mixed dynamics of urbanicity and rurality, conservative influences, and industrial roots (Garay-Huamán & Irazábal-Zurita, 2021) create a unique context with teacher labor market characteristics that do not fully reflect the patterns observed at the national level (Nguyen, 2020b). Such distinctive geographical, socioeconomic, and political circumstances of Kansas add complexity to policy considerations for sustaining a diverse and strong teacher workforce.

Given the chronic teacher staffing and retention challenges in the understudied context of Kansas, a thorough analysis of Kansas teachers and their mobility is urgent. Leveraging the state's longitudinal administrative data over the past 15 years, from 2010 through 2024, I analyzed the characteristics and mobility patterns of Kansas. This study is the first and most comprehensive analysis of the Kansas teaching force, offering critical insights to inform policy interventions and practices that aim to sustain teachers in the state, as well as potentially addressing regional disparities in teacher characteristics and quality across the state's geographically diverse regions. This research contributes to the collective understanding of the teacher workforce with evidence from a traditionally overlooked context, including insights regarding how teacher characteristics and mobility have changed over the COVID-19 pandemic.

Research questions

My research addresses the following questions:

RQ1. To what extent did Kansas public school teachers turn over from 2010-2011 through 2023-2024?

RQ2. To what extent did attrition among Kansas public school teachers differ by teachers' teaching disciplines (STEM, CTE, and SPED/ESOL) and school and student contexts (school locale, and student racial and socio-economic compositions)?

RQ3. To what extent are teacher disciplines and salary predictive of turnover among Kansas public school teachers?

Addressing RQ1, I seek to explore the extent to which Kansas teachers turned over in the most recent 15 years, capturing how their turnover patterns have changed over the COVID-19 pandemic. This provides the state with evidence regarding the urgency of their teacher staffing challenges, thereby informing conversations among policymakers, administrators, and teacher educators. Despite relying on purely descriptive statistics, this is critical information, as policymakers and administrators are more likely to respond to sustained and continuing periods of high turnover (Sorensen & Ladd, 2020).

Addressing RQ2, I seek to observe whether there is substantial variation in turnover among teachers of different areas of discipline, as well as varied school geographical settings and diverse student populations. If substantial variations exist among these groups of teachers and/or school and student contexts, one-size-fits-all policies, or policies that fail to address such variations, are unlikely to encourage teacher retention, thereby falling short of mitigating the state's teacher staffing challenges. Moreover, such policies are likely to perpetuate gaps in access among diverse students to sustained teacher workforces, which have been consistently shown in the literature to significantly influence their learning (Hanushek et al., 2016; Henry & Redding, 2020; Ronfeldt et al., 2013; Sorensen & Ladd, 2020).

As for RQ3, I seek to understand whether turnover among teachers of different areas of discipline is differentially associated with salary, as there has been substantial interest in the literature and across educational discourses regarding differential financial incentives and compensations among teachers, especially those serving in hard-to-staff schools and/or subject areas (Anglum et al., 2024; Bueno & Sass, 2019; Clotfelter et al., 2011; Strunk & Zeehandelaar,

2011). This will inform Kansas as the state strives to recruit teachers for hard-to-staff subject areas and locations, such as through the Kansas Teacher Service Scholarship (The Kansas Board of Regents, 2024).

Moreover, given Kansas's mixtures of urban and rural dynamics, STEM teacher turnover may be differentially associated with salary relative to their colleagues of other disciplines, given the wide range of non-teaching STEM employment opportunities in nearby industries (Lam et al., 2025). Meanwhile, SPED/ESOL teacher turnover is likely to be associated with salary in distinctive ways due to the unique and complex nature of their work (Billingsley & Bettini, 2019).[1] Furthermore, adjacent states, such as Missouri, have been pursuing teacher pay reform policies, most notably S.B. 727 (Senate Bill No. 727, 2024), which will create pathways for within-district differentiated pay for teachers teaching hard-to-staff subject areas. This analysis will inform Kansas policymakers on the nuances of the association between teacher salary and turnover, suggesting what is possible should the state pursue similar policy interventions.

[1] I am cognizant of the distinctive characteristics between SPED and ESOL teachers, yet these two areas could not be consistently and separately identified within KSDE data. More details on this are in Chapter 3.

Chapter 2 - Literature review

Literature landscape

Since the 1970s, research has identified teacher characteristics such as gender, age, race and ethnicity, family background, marital status, spouse employment, academic ability, career orientation, commitment, and satisfaction as significant influences to teacher attrition (Billingsley, 1993; Chapman, 1983; Guarino et al., 2006). The association between teacher turnover and race was however considered inconclusive (Billingsley, 1993), while more recent studies found little evidence for the association between teacher attrition and gender (Nguyen et al., 2020). Another shift in the literature regards teachers' career satisfaction and commitment, though being consistently found significant to teacher turnover. In particular, the 1980s literature identified career satisfaction as a standalone factor, separated from teachers' demographic and professional characteristics (Chapman, 1983), while subsequent studies considered it together with stress and commitment to teaching, forming a category of "affective responses to work" (Billingsley, 2004). In the most recent synthesis of teacher attrition, these elements are classified as "teachers' personal factors" (Nguyen & Springer, 2023).

Meanwhile, a host of school characteristics have been recognized as significant factors of teacher mobility, ranging from the physical conditions of the classroom and the building to nonphysical conditions of the teacher's immediate work environment, including class size, campus climate, collegial relationship, and autonomy in the classroom (Billingsley, 1993, 2004; Chapman, 1983; Nguyen et al., 2020). Other school factors include school locales, school types (e.g., charter, magnet, alternative), sizes (e.g., enrollment totals), amounts of resources, instructional and noninstructional expenditures, and student body characteristics, namely demographic and socioeconomic compositions, achievement, and discipline levels (Borman &

Dowling, 2008). Still other factors within the school include support for teachers, especially administrative support, administrator effectiveness (Nguyen et al., 2020), and whether teachers are actively involved in decision making at the school level (Billingsley, 1993).

An important factor of teacher turnover that has been much written about is teacher salary. The early work identified teacher salary among the elements of the teacher's working environment (e.g., Billingsley, 2004), or one of the "conditions of service" (Macdonald, 1999). The more recent literature, however, pointed out public education is unique as employee salary is determined not by market forces but public policies (García & Weiss, 2019a), thus considering salary a turnover factor external to the school, along with compensation-related guidelines and policies such as fringe benefits, retention bonus, and merit pay (Guarino et al., 2006; Nguyen et al., 2020; Nguyen & Springer, 2023; Pham et al., 2021). Relatedly, there has not been a study that could isolate the effect of salary on teacher turnover, while the association between salary and turnover varies greatly (Grissom et al., 2016), with the most rigorous estimation from state-level administrative data suggesting one percent increase in salary is associated with a 0.16 percentage-point decrease in the probability of overall turnover (Hendricks, 2014).

More broadly, teacher attrition is associated with a variety of social, economic, and political factors. The early work considered such factors as "conditions that affect service" (Macdonald, 1999), entailing a wide range of conditions ranging from socioeconomic and political circumstances (e.g., financial or political crises, economic recession, economic growth) to large-scale shifts in populations, at both local and national levels; as well as the status of teachers in society, particularly how teachers are perceived by the surrounding, namely parents, local communities, and governments (Chapman, 1983). Perhaps the most obvious contribution these broadly external factors make to teacher turnover is through teacher qualification and

accountability policies (Nguyen et al., 2020). In particular, the No Child Left Behind (NCLB) Act of 2001 differentiated teacher turnover by tightening qualification requirements, in combination with limited working conditions, especially in high-poverty and remotely rural schools, not only disincentivizing teachers but also driving them out of the profession (Darling-Hammond, 2010; McClure & Reeves, 2004).

Conceptual framework

For the complex nature of teacher attrition, it is necessary to proceed through the body of literature that guides my study and subsequent analyses via a consistent lens. For this reason, I adopt Nguyen and Springer's (2023), the most recent synthesis of nearly 40 years of teacher retention and attrition research, and the most comprehensive framework to date.

As described, Nguyen and Springer (2023) identified three domains of teacher attrition factors: personal factors, school factors, and external/policy factors. Teachers' personal factors include demographic characteristics (e.g., age, race, gender), family backgrounds (e.g., marital status), and teacher qualifications (e.g., experience, certification, degree). School factors encompass school organizational characteristics (e.g., school size, type, locale), resources (e.g., class size, expenditure), and student body characteristics (e.g., achievement, discipline, racial and socio-economic representations). External/policy factors include teacher salary, accountability policy, school improvement interventions, and broad workforce conditions (Figure 1).

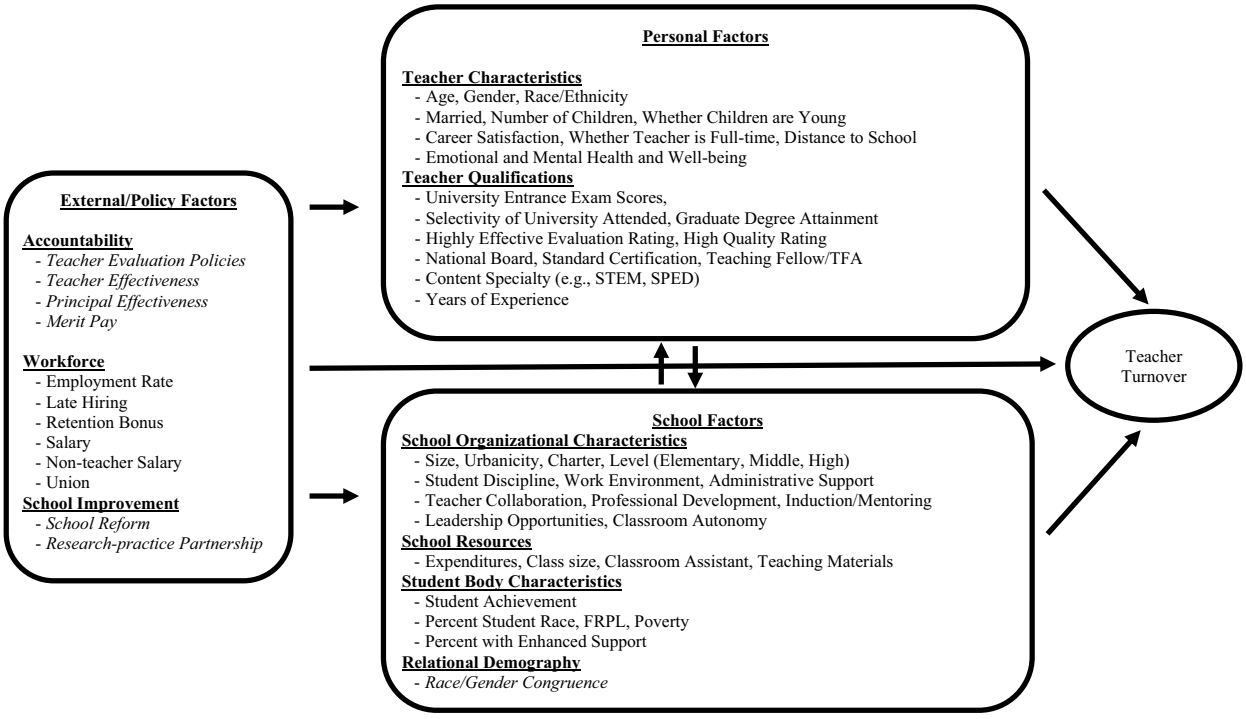


Figure 1. Conceptual framework of teacher attrition (Nguyen & Springer, 2023, p. 1000)

Teacher retention and attrition in Kansas

Within the unique geographical, social, and political context of Kansas, insights offered by the research literature carried out at the national level and from other states are not fully applicable. For this reason, I explored the body of works that specifically examined the mobility of Kansas teachers over the past several decades. In the below synthesis, I highlight the findings from these Kansas-specific studies, following Nguyen and Springer's (2023) framework.

First, similar to the patterns observed in the general literature, the Kansas-specific research identified age, gender, family responsibilities, teaching discipline, and career advancement as factors of teacher attrition (Fowler, 1954; Hower, 1963; Keeley, 1959). Keeley (1959) noted gender differentiated the association between teacher mobility and family factors, specifically men tended to switch jobs for career advancement, while women were more likely to do so for family responsibilities. The research in subsequent decades, while echoing these early

findings, highlighted different turnover patterns between general and special education teachers, and among general education teachers of different teaching levels (Stewart, 2016; Tompkins et al., 1999) and subject areas (Lashier & Ryoo, 1984; Stewart, 2018; Tompkins et al., 1999).

Other teachers' personal factors include stress, emotional wellbeing, and teacher qualifications. In particular, stress and emotional wellbeing as attrition factors were consistently reported among general education (Clagg, 2002; Heffley, 1983; Nassar, 1989; Northup, 2018), and special education teachers (McKnab, 1983, 1993). Meanwhile, Kells (1982) found teacher competencies significantly related to the mobility of special education teachers, whereby reported insufficient preparation as a factor of their attrition. Echoing this finding, other studies noted teacher preparation was a significant turnover factor of early-career math and science teachers and teachers serving in rural schools, including the selectivity of the university they went to, graduate degrees, and experiences in practicum and student teaching (Nassar, 1989; Nguyen, 2020b; Wright & Nassar, 1991).

Regarding school factors, research in the 1950s found dissatisfaction with the school administration was frequently reported among teachers' reasons for turnover (Keeley, 1959). The school administration would continue to be reported consistently as a turnover factor throughout the decades that followed (e.g., Friesen, 2016; Hart, 1972; McKnab, 1992). Also consistently found significant to teacher attrition are teachers' immediate working conditions, including class size, workload, and the amount of non-teaching assignment (Clagg, 2002; Hart, 1972; Heffley, 1983; McKnab, 2002; Nance & Calabrese, 2009; Nassar, 1989; Northup, 2018; Zabel & Zabel, 2002). Notably, non-teaching responsibilities such as paperwork and record keeping stood out as a significant turnover factor of special education teachers, as reported by all studies within the special education strand of the Kansas-specific literature (McKnab, 1983, 1993; Nance &

Calabrese, 2009). Relatedly, school locales, including urban, suburban, and rural, as well as school sizes, by total student enrollment and total teachers employed (McKnab, 1983; Northup, 2018; Stewart, 2016), were also found associated with teacher turnover.

One highlight of the Kansas teacher attrition literature pertaining to school factors is relationships and subsequently support for teachers within the school. The relationship between teachers and administrators, as well as administrative support were found to be significant turnover factors throughout the literature (Clagg, 2002; Ewy, 2007; Green et al., 2005; McKnab, 1983, 1993, 2002; Nance & Calabrese, 2009; Nassar, 1989; Zabel & Zabel, 2002). Collegiality or the relationship among fellow teachers were equally important, including collaboration and support the teachers have for each other (Clagg, 2002; Nassar, 1989; Northup, 2018; Zabel & Zabel, 2002). Two studies suggested not only collegiality, but also the level of collegial knowledge in the school was significantly associated with teacher turnover (Nassar, 1989; Zabel & Zabel, 2002). One study underscored the significance of collegial quality via peer turnover, as the departure of certain teachers diminished collegiality among those who decided to stay, thereby lowering their morale and encouraging them to also resign (Northup, 2018).

Offering even more insights, several studies dived deep into the specifics of what relationships and support mean to teachers when it comes to career mobility. To special education teachers, support from the general administrators, special education administrators, and other teachers for their work, especially in the regular classroom, were found critically important to their retention (McKnab, 1983; Zabel & Zabel, 2002). Different types of support were also perceived differently, wherein appreciation and recognition were deemed the most important, followed by environmental and technical support (Ewy, 2007). To early-career teachers, the relationships with veteran teachers, especially their mentors during inductions, were

crucial for their retention (Green et al., 2005). In this respect, Johnson (2007) found mentor-mentee congruences (e.g., in subject areas and grade levels), as well as the frequencies of their interaction played crucial roles in their success in school, and subsequently retention.

The last, but certainly not least, school factors pertain to students. In one study, relationships and interpersonal communication between teachers and students were considered the most important factor to teacher retention (Nassar, 1989). Others found student behaviors, student diverse needs, and the overall level of student discipline in school were significant factor of teacher attrition (Hart, 1972; Northup, 2018). Another study found student demographic and socioeconomic compositions in the school associated with early-career teachers' mobility among schools (Johnson, 2007).

Beyond the teachers and the school, the Kansas teacher attrition literature offers insights regarding the association between mobility and external circumstances, including living conditions, monetary concerns, and local, state, and federal education policies. Research in the 1950-60s suggested the size of the town in which the school is located and how remote it is differentiated mobility patterns among teachers (Fowler, 1954; Hower, 1963; Keeley, 1959). More recent studies added the supportive climate of the local community, along with the successful traditions of the school district, were critical to teacher retention (Friesen, 2016). Teacher attrition rates also varied among different geographical regions of the state (McKnab, 1992). Echoing this finding, Stewart (2016, 2018) suggested mobility of Kansas teachers was differentiated by geographical region and the subject area in which the teachers teach.

On monetary concerns, similar to the patterns observed among U.S. teachers overall, teacher salary was among the first and most consistently reported factors of teacher attrition in Kansas (Clagg, 2002; Friesen, 2016; Hart, 1972; Heffley, 1983; Hower, 1963; McKnab, 1983;

Nassar, 1989; Northup, 2018; Wright & Nassar, 1991). Notably, several studies not merely reported salary as a turnover factor but also explored its nuanced association with teacher turnover. Clagg (2002) reported teachers' concerns over benefits in addition to salary among early-career teachers, while Friesen (2016) found that it was not the dollar amount, but the relative compensation to living cost that influenced teachers to stay in school. Compensation policy, specifically merit-based pay raises, was also reported as a significant concern to early-career teachers, especially to those who had had children (Green et al., 2005).

Regarding policy factors, Northup (2018), researching teachers in Title-I and non-Title-I schools in Kansas City Metropolitan area, found systematic changes in pull-out programs, equity across Title-I and non-Title-I schools, and community partnerships were the most significant motivations for teachers to remain in Title-I schools. Johnson (2007) highlighted different turnover patterns between high- and low-poverty schools in the Kansas City Metropolitan area when the NCLB legislation began effective. In another study, the enactment of NCLB together with the Individuals with Disabilities Education Act (IDEA) was found associated to the slight decline in attrition rate among new teachers in the Leavenworth County Special Education Cooperative in Northeastern Kansas, though the overall attrition rate of the school site remained high before and after the policy implementation (VanCise, 2013). Lastly, Nguyen (2020b) examined Kansas teacher attrition within the broader contexts of Midwest and Great Plain states, suggesting Kansas teachers were more likely to turn over than Midwestern teachers, and more likely to switch schools compared to teachers in the Great Plain.

Literature gaps

The research examining Kansas teacher mobility has identified a wide array of turnover factors, ranging from teacher characteristics, school factors, and external influences. However,

these studies are limited in several important ways, and there has not been any study that longitudinally and comprehensively examine Kansas teacher attrition.

In detail, much of the Kansas-specific research only employed descriptive statistics, mostly frequency tables with percentages, to arrive at their findings (e.g., Fowler, 1954; Heffley, 1983; Hower, 1963; Jones, 1967; Keeley, 1959; Lashier & Ryoo, 1984; McKnab, 1983, 1992, 1993, 1995, 2002; Scannell, 1984; Stewart, 2016, 2018; Tompkins et al., 1999; VanCise, 2013). Others employed mixed method designs (e.g., Green et al., 2005; Johnson, 2007; Kells, 1982; Skillett, 1981), of which the quantitative component was mere descriptive, while some were pure qualitative research (e.g., Clagg, 2002; Friesen, 2016; Hart, 1972; Nance & Calabrese, 2009; Northup, 2018). These studies are valuable for describing the nuanced characteristics of Kansas teacher turnover but fall short of providing a comprehensive analysis of the turnover patterns.

Meanwhile, the studies that employed inferential statistics were limited either by their statistically week research designs, or limited sample sizes. For instance, in Nassar's (1989), the author administered a survey, the primary research instrument, to 320 teachers, but only 128 responded. In Zabel and Zabel's (2002), 301 survey responses were analyzed from a survey of 420 special education teachers. Similarly, Ewy (2007) recorded 276 responses from 600 questionnaires sent to special education teachers and building administrators. One study employed a relatively large scale regression analysis (Nguyen, 2020b), but the data were cross-sectional in structure and were collected via a national survey, leading to a severe sample reduction when filtering out non-Kansas teachers, thus limiting its statistical inferences.

Finally, all of the existing research, though spanned across several decades, were conducted before the outbreak of the COVID-19 pandemic, with the latest data collected in the 2012-2013 school year (Nguyen, 2020b), and the vast majority only examined data from teachers

of a single or a few subject areas instead of examining the Kansas teacher workforce as a whole (e.g., Ewy, 2007; Nance & Calabrese, 2009; Stewart, 2016, 2018; VanCise, 2013; Zabel & Zabel, 2002). For these reasons, an examination of teacher attrition in Kansas that leverages the state's longitudinal administrative data with large sample sizes and updates from the years before, during, and after the pandemic is critically timely and important for policymakers.

Chapter 3 - Data and Methods

Data sources and curation

For this study, I employed data from the Kansas State Department of Education (KSDE), particularly administrative data collected via the Kansas Educator Data Collection and the License Personnel Report (LPR-EDCS) system, from 2010 through 2024, including demographic characteristics, qualifications, and employment including district and school information, course assignments, and full-time or equivalent status (FTE), on all public-school teachers in Kansas.

I curated the data for teachers in public elementary and secondary schools, excluding central offices, off-site/community-based schools, and specialized educational services and/or programs such as Early Childhood Head Start, summer schools, learning centers, and special education service centers due to the inconsistent reporting of these units over time.

There were a number of teachers being reported with multiple observations in the same school year, as they served more than one school in the same district, and/or in multiple districts within the state. To obtain a panel data structure suitable for the analysis, which requires one observation per unit of analysis (i.e., teacher) for every unit of time (i.e., school year), I collected the school where the teacher primarily taught, identified by their highest FTE within the school year. If a teacher was employed in more than one school with the highest FTE within the school year, I used a random, two-step selection computerized procedure to retain one of those equivalent positions. I began by randomly selecting one school from every district the teacher was employed in, then randomly selected one district, now associated with only one school, to determine the final teacher-year observation for the panel. This ensured every primary, as in highest-FTE, employment position of each teacher each year had an equal chance of being retained for the analysis, thereby maintaining the highest-possible data quality.

I then merged the curated teacher data with the National Center for Education Statistics' (NCES) Common Core Data (CCD) to obtain information on the school factors of teacher attrition, including operational status, grade levels, student enrollment numbers, student body characteristics including race, gender, and eligibility for free- or reduced-price lunch (FRPL), and school locale (city, suburban, town, and rural).

More specifically, a city school if it is located inside a principal city; a suburban school if it is located outside of a principal city but still within an urbanized area; a town school if it is located outside of an urbanized area but still within an urban cluster; and, a rural school if it is located outside of an urban cluster (National Center for Education Statistics, 2022).[2] In essence, the NCES's locale classification is a measure of the school's location relative to city centers. It does not capture nuances among communities with varied conditions that are essential to a teacher's life and work, such as the availability of services and amenities in the area, thereby obscuring variations in their mobility (Goldhaber et al., 2020; Rhinesmith et al., 2023).

Due to this limitation in the school locale variable, I merged the data with district-level Community Assets and Relative Rurality (CARR) measures (Nelson & Nguyen, 2023) to account for the circumstances that are external to the school but potentially associated with teacher mobility (Nguyen et al., 2020). Instead of using the composite CARR index, which encompasses the distance to city component that overlaps with the NCES measure, I employed CARR data on the availability and accessibility of community services and amenities within the district's local community, including essential services (e.g., childcare centers, banks, schools), amenities (e.g., restaurants, libraries, arts centers), infrastructure and natural resource sites (e.g.,

[2] NCES does provides subcategories (e.g., large, mid-size, and small city) operationalized by different combinations of population and distance values. These are only consistent within the major categories and not across them.

roads, utilities, residential or commercial amenities), as well as the area's population density, and the percent of developed land, where an area with a higher percent of land covered by developments such as residential homes, apartment complexes, or commercial facilities are considered more urbanized relative to areas with more open land (Nelson & Nguyen, 2023).

For example, USD 437 Auburn-Washburn, located on the edge of Topeka, has half of its schools classified as rural in the CCD. However, the district's community is within the highest 10% of service and amenity availability, accessibility, population density, and percent developed land, relative to other districts in Kansas. For simplicity, I refer to these components together as "relative urbanicity," following Nelson and Nguyen (2023) terminology. Similarly, USD 232 De Soto, residing on the edge of Kansas City, has five out of its 12 schools categorized as rural, while also being in the highest 10% or relative urbanicity. It is therefore reasonable to expect teacher mobility from these relatively more urbanized schools, despites being located outside of an urban cluster, differs from mobility among teachers in rural schools with lower levels of relative urbanicity, such as Quinter Public Schools, USD 293, or those further west of Kansas, like Triplains, USD 275, or Greeley County, USD 200, where community asset availability, accessibility, population density, and percent developed land are in the lowest 10% of the state.

Finally, before proceeding with the analysis, I examined all the observations included in the combined dataset for problematic records. I found a number of teachers did not have complete data, such as by missing some information from the KSDE data, or the CCD. I excluded these teacher observations to ensure consistency in the analysis. These accounted for 1.42% of total number of teacher-year observations, with the year-to-year rates ranging from less than 1% to 4.04% (Appendix Table A2). The final set of data retained for analysis contains a total of 457,346 teacher-year observations, providing information on 67,177 individual teachers,

who served Kansas public elementary and secondary schools across 286 districts in the state over the past 15 years, from 2010 to 2024.

Identifying teacher mobility

For the purpose of the study, I identified five different forms of teacher mobility, including *stayer*, *school switcher*, *district switcher*, *leaver*, and *closure mover*. Given a school year and its operation status, a *stayer*, or returning teacher, is the one who would remain employed in the same position through the immediately next school year. In this vein, a *school switcher* is identified if the teacher switched to another school but remained in the same district. A *district switcher* is identified if they switched to a different district in the same state. A *leaver* is identified if the teacher was no longer observed in the state's public elementary and secondary schools. Finally, if the school was closed and the teacher was forced to move (either to another school or out of the system), they were classified as a *closure mover*. I did not focus on the mobility of closure movers, but they must be identified to be separated from the analysis of other turnovers. The (non-closure) switchers and leavers comprised the group of turned over teachers, henceforth the measure "overall turnover," the focus of all three research questions.

It is important to note that KSDE data did not provide sufficient information to disaggregate further the mobility forms of leavers. Leavers are not necessarily teachers who completely leave teaching. In particular, a leaver is potentially an interstate switcher, if they moved out of Kansas to teach in another state. They might also switch to another school in the state that was not observable from the data, such as a specialized unit, an educational service center, a private school, et cetera. From the perspective of Kansas's public elementary and secondary schools, either the teacher resigned from teaching or moved to these unobservable

units, the mobilities are essentially the same. Examining these mobilities would have been worthwhile, but was not feasible, and at the same time, out of scope to my present study.

Though lacking sufficient information on the leavers' destinations, the longitudinal nature of the data does have an advantage. I was able to observe whether the teachers who departed as leavers return to the state's school system. I thereby identified two additional mobility forms: long-term leavers and short-term leavers. A long-term leaver is identified if a teacher left the state's public elementary and secondary schools and did not return, either to the same school or another school within the state, for more than three years. Vice versa, a short-term leaver is identified if a teacher left but came back to the system within three years. For example, if a teacher left the state's school system in 2010-2011 and did not return until 2013-2014, I identified them as a long-term leaver. Meanwhile, if a teacher departed in 2010-2011, which means they were not observed within the system in 2012-2013, but came back in either 2012-2013 or 2013-2014, I identified them as a short-term leaver. I chose the three-year window as it was natural to consider a less-than-three-year departure temporary. Besides, there might be some considerable depreciation in the teacher's familiarity with the schools, students, or curricula, if they left the system for over three years, as shown in the human capital literature (e.g., Dinerstein et al., 2022). Unfortunately, the current dataset only allows the observation of short- and long-term leavers up to the 2020-2021 school year. These additional measures are not the focus of my analysis, but help shed light on the dynamics of Kansas teacher mobility, thereby informing policy considerations in the state.

Identifying teacher types

I identified teacher types with a focus on three teaching area categories: Science, Technology, Engineering, and Mathematics (STEM), Career and Technical Education (CTE), and Special Education and English for Speakers of Other Languages (SPED/ESOL).

A STEM teacher is identified if they primarily taught (i.e., with the highest FTE) in a non-elementary school (i.e., middle, high, or other-level schools) in the areas of mathematics, computer science, and natural sciences that include biology, chemistry, earth and space science, and physics. For computer science, I only included the subject matter that directly stemmed from mathematics, such as algorithm development or programming methodology, while excluding those that generally covered computer applications. I did not include technology and engineering in the STEM category, as they are more on the CTE end if placed on a STEM-CTE spectrum. The subject areas in these two fields were therefore included in the CTE subject category.

I also excluded elementary-school teachers from the STEM teaching category, as general and subject-specific teachers in elementary school were not clearly distinguished in KSDE data, especially in the early years of the panel. Besides, from Kansas's certification perspective, there are no STEM teachers in elementary grades. In particular, Kansas offers STEM certification pathways only for middle- and secondary-level teachers (grades 5-8 and grades 7-12), while the elementary certification (grades K-6) allows teachers to teach both general and STEM subjects.

Meanwhile, a CTE teacher is identified if they primarily taught in the areas of CTE or vocational education, including agriculture and natural resources; business management and support; marketing and distribution; healthcare occupations; construction, trades, engineering, or science technologies (e.g., Computer-Aided Design and Drafting, CADD), mechanics and repair; manufacturing or precision production (e.g., electronics, metalwork, textiles); communications

and related technologies (e.g., design, graphics, or printing, but not computer science); personal and public services (e.g., culinary arts, cosmetology, child care, social work, protective services, custodial services, interior design); family and consumer sciences; and, industrial arts or technology education.

There were a number of teachers in the dataset that taught both STEM and CTE areas within the same school. This is naturally expected, especially in the current school context with teacher staffing challenges, where STEM teachers are often asked to teach a CTE subject for their expertise in technological areas. I therefore identified CTE teachers by those who did not have other assignments in the areas of mathematics, natural sciences, and computer science, as specified in the identification for STEM teachers. Stated otherwise, I identified CTE teachers as non-elementary, non-STEM teachers who primarily taught CTE subjects.

Finally, the SPED/ESOL category includes teachers who primarily taught in the areas of SPED (e.g., adaptive, functional, low-, and high-incidence, gifted, etc.) and/or ESOL. I am cognizant of the distinctive characteristics between SPED and ESOL teachers, yet these two areas could not be consistently and separately identified within KSDE data. The specific SPED/ESOL assignment indicators in KSDE data were only available from the 2012-2013 school year (Kansas State Department of Education, 2012), yet contained over 90% missing values a year throughout the panel (from 2012-2013 through 2023-2024).

The STEM, CTE, and SPED/ESOL subject area categories were systematically categorized for all years using a computer algorithm that I developed. The algorithm operates using two sets of keywords: a search string, and a counter-search string. In each search, it begins by searching through the dataset to identify all course titles containing the keywords specified in the search string, then removes those containing the keywords specified in the counter-search

string. As an example, to record natural sciences for the STEM category, I included the term "science" in the search string, and terms like "family," "consumer," "health," "military," "social," "behavioral," "political," and "fiction" in the counter-search string. The algorithm would then record all course titles with the word "science," then exclude such titles that were not natural sciences as "family and consumer sciences," "military sciences" or "political sciences." This search-counter search approach allowed the algorithm to be highly flexible, and able to be improved through iterations. I initially adapted the search and counter-search strings from official lists of subject areas from KSDE and NCES websites, then reiterated the algorithm to finalize the strings that were the most suitable for the dataset.

The school levels were also systematically identified based on the 2016-2017 school level logic by NCES (National Center for Education Statistics, 2023). This identified four categories of school level: elementary, middle, high, and others, which encompass all other grade level combinations offered by the school that were not able to be classified into the former three. Although NCES changed to the 2017-2018 approach for the classification of school levels, KSDE data did not offer sufficient details to follow such classification. Together with the systematic identification of subject area categories, I obtained a consistent measure of teacher types by their teaching disciplines and grade levels.

The identification strategy resulted in a five-category, mutually exclusive teacher type classification, including SPED/ESOL (all levels), elementary (non-SPED/ESOL), STEM, CTE (non-STEM), and other non-elementary, non-STEM/CTE teachers (Figure 2). This last category includes teachers who primarily taught in the areas of non-elementary social sciences, language arts, and PK-12 disciplines such as fine and performing arts, health and physical education, as

well as miscellaneous subjects such as driver education, military or Reserve Officers' Training Corps (ROTC), philosophy, religion, and so on.

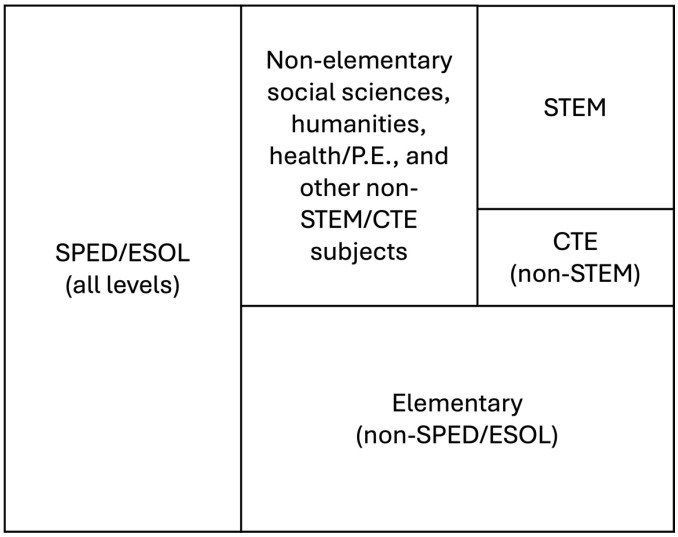


Figure 2. Teacher type identification strategy

In addition to identifying the teachers' teaching categories, I also categorized their certifications, specifically STEM, CTE, and SPED/ESOL to control for qualification factors while examining the teachers' mobility patterns. The certification areas were also classified by my computerized procedure, of which the search and counter-search strings had also been refined through multiple iterations. However, due to the insufficiency of effective and expiration dates in KSDE data, I could not determine the active periods of the teachers' certification. As a result, I identified certified teachers as those who had ever been certified in one of the classified subject categories. This approach certainly has limitations. For example, it may inflate the annual number of STEM-certified teachers by including those who had not yet attained a STEM certification, or those whose STEM certifications had expired. The detailed description of all variables/measures is provided in Appendix Table A1.

Analytic approaches

To address the research questions, I employ both descriptive and regression analysis, particularly linear probability models (LPM). I address RQ1 by analyzing annual turnover rates among Kansas teachers who served in the state's public elementary and secondary schools over the past 15 years. This includes overall and form-specific turnovers (i.e., school switcher, district switcher, and leaver) from 2010-2011 through 2022-2023. The data from the 2023-2024 school year were utilized to identify the teachers' mobility from the 2022-2023 school year.

Addressing RQ2, I examine turnover rates by the teachers' teaching categories (Elementary, STEM, CTE, SPED/ESOL, and other non-elementary), school locale (city, suburban, and rural/town), and student body characteristics, including racial/ethnic composition by annual school-level halves by percent of students of color, and socio-economic composition proxied by annual school-level halves based on the school's percent of FRPL-eligible students.

I note that while some prior work relied on fixed percentage-point benchmarks (e.g., 25, 50, or 75%) to categorize schools based on student characteristics (e.g., Ingersoll & May, 2012; Nguyen et al., 2023; Simon & Johnson, 2015), I used annual school halves to account for the heavily skewed and changing distributions of student characteristics in Kansas. In particular, a school is identified as a high-minoritized school if it is within the highest 50% of the schools in the sample (i.e., upper median) by percent of students of color within the school year. Similarly, a school is identified as a high-impoverished school if it is within the highest 50% of the schools in the sample by percent of students eligible for FRPL, also within the school year. This means a school can be reclassified from high- to low-minoritized if its student population shifted toward serving a percent of White students that is higher than the rest 50% of schools in the sample. To contextualize my findings, I report these annual school half indicators in Appendix B.

To further examine if differences among turnover rates by teacher, school, and student contexts remain significant after accounting for other covariates of teacher attrition, I conduct regression analysis. The regression equation is expressed as follows:

$$Y_{isdct} = \beta_0 + \boldsymbol{Ttype}'_{\boldsymbol{isdct}}\beta_1 + \boldsymbol{Work}'_{\boldsymbol{sdct}}\beta_2 + adjsal_{isdct}\beta_3 + \boldsymbol{TScov}'_{\boldsymbol{isdct}}\beta_4 + relative\_urbanicity_d\beta_5 + \boldsymbol{Flag}'_{\boldsymbol{isdct}}\beta_6 + c + t + \epsilon_{isdct}.$$

In the equation, Y_{isdct} represents the turnover outcome for teacher i from school s, district d, county c, in year t, which equals one if the teacher turned over and zero if they stayed.

Among the covariates of interest, $\boldsymbol{Ttype}_{\boldsymbol{isdct}}$ is a vector of teacher factors of interest, particularly their teaching categories, including STEM, CTE, other non-elementary (henceforth "non-ELE"), and SPED/ESOL. As the categories are mutually exclusive, the reference group for teacher types is the non-SPED/ESOL elementary teachers. Meanwhile, $\boldsymbol{Work}_{\boldsymbol{sdct}}$ is a vector of school and student contexts of interest, including school locales, and halves of student racial and FRPL eligibility compositions. I refer to these school and student factors as "working conditions," as they are often strongly indicative of teacher working conditions, with those in remotely rural locations or schools serving a high percent of historically marginalized students are often more challenging than in less isolated or more affluent areas (Bettini et al., 2016; Nguyen, 2020a, 2021). Lastly, $adjsal_{isdct}$ represents the inflation-adjusted total salary of the teacher, including base salary, fringe benefits, and/or other compensations. This covariate is a control variable for the analysis of RQ2, accounting for one of the external/policy factors of teacher attrition, as well as covariate of interest for RQ3. In other words, the estimate on $adjsal_{isdct}$ not only contributes insights into the general patterns of Kansas teacher attrition (RQ2) but also helps inform the analysis of whether the association between teacher turnover and salary is differentiated among their teaching categories (RQ3).

As for other control variables, $\boldsymbol{TScov_{isdct}}$ is a vector of teacher and school covariates. The first set of factors in $\boldsymbol{TScov_{isdct}}$ includes the teacher's demographic characteristics (female, teacher of color) and qualifications (novice/up to three years of teaching, certifications, and graduate degrees). Meanwhile, the second set of $\boldsymbol{TScov_{isdct}}$ controls for the teacher's working environment, including their FTE in the school, the school's student enrollment (per 10,000), as well as its percent of female students (0-100). Moreover, $\boldsymbol{TScov_{isdct}}$ contains indicators for whether the teacher served in more than one school within a single district, and whether they served in two or more districts within a school year. These indicators account for the teacher's positions that were not retained for analysis, either by FTE or the random curation. Besides, serving multiple positions in a school year, especially if those positions are in different districts, likely increases the complexity of the teacher's job, thus may be associated with their mobility.

Meanwhile, $relative\_urbanicity_d$ represents the percentile of the school district relative to other districts in the state by a recombined CARR measure, $CARR_{recom}$, that captures the district's community asset availability, accessibility, population density, and the percent of developed land. This measure utilized CARR data from Nelson and Nguyen's (2023), following their weighting scheme of the original CARR composite index, while excluding the distance to metropolitan area component:

$$CARR_{recom} = Avail - \frac{1}{3}(Access_1 + Access_2 + Access_3) + \frac{1}{2}\left(Pop_{density} + Land_{percdeveloped}\right).$$

Within this combination, the first component, $Avail$, captures the availability of services and amenities in the district's community. Meanwhile, the components $Access_1$, $Access_2$, and $Access_3$ capture aggregated distances from the service or amenity to the community's block

group areas, for which higher levels correspond to less access to such service or amenity. Lastly, $Pop_{density}$, and $Land_{percdeveloped}$, capture the community's population density, and the percent of its developed land. As a result, the higher the $CARR_{recom}$'s value, the higher the district's relative urbanicity.[3] To aid interpretation of the findings based on $CARR_{recom}$, I transformed it into percentiles, hence the notation $relative\_urbanicity_d$, leveraging the advantage of the continuous nature of CARR data relative to traditional measures (Nelson & Nguyen, 2023).

Beyond the covariates, I include $\boldsymbol{Flag'_{isdct}}$, a vector consisting of flags of outliers and/or abnormally recorded data in terms of FTE and salary figures (e.g., annual salary of $1,000 for a full-time teacher, or FTE higher than 2.0). These flags account for the potential irregularities in the data, either due to KSDE's reporting system or the teacher's job. Moreover, I include county- and year-fixed effects to account for county- and time-invariant factors that are unobservable from the data, such as the local workforce conditions or broad societal circumstances, alleviating the issue of omitted variable biases. Finally, ϵ_{isdct} represents the unobservable error term. All models employ heteroskedasticity-robust standard errors clustered at the district level.

Addressing RQ3, I interact the teacher's teaching category and their annual inflation-adjusted total salary, while keeping all other elements of the equation, as follows:

$$
\begin{aligned}
Y_{isdct} = \beta_0 &+ STEM_{isdct}\beta_{11} + CTE_{isdct}\beta_{12} + Other\_nonELE_{isdct}\beta_{13} + SPED/ESOL_{isdct}\beta_{14} \\
&+ adjsal_{isdct}\beta_3 + STEM_{isdct}adjsal_{isdct}\tilde{\beta}_{11} + CTE_{isdct}adjsal_{isdct}\tilde{\beta}_{12} \\
&+ Other\_nonELE_{isdct}adjsal_{isdct}\tilde{\beta}_{13} + SPED/ESOL_{isdct}adjsal_{isdct}\tilde{\beta}_{14} \\
&+ \boldsymbol{Work'_{sdct}}\beta_2 + \boldsymbol{TScov'_{isdct}}\beta_4 + relative\_urbanicity_d\beta_5 + \boldsymbol{Flag'_{isdct}}\beta_6 + c \\
&+ t + \epsilon_{isdt}.
\end{aligned}
$$

[3] In Nelson & Nguyen (2023), the CARR composite index measures the relative rurality of an area, which served their research purposes. This is opposite to the relative urbanicity/recombined CARR measure in my current study.

In this analysis, the interaction coefficients represent the marginal association between an increase in the teacher's inflation-adjusted annual total salary and the potential change in their turnover outcome, given their teaching category, relative to non-SPED/ESOL elementary teachers (i.e., the reference group). For example, $\tilde{\beta}_{11}$ represents the potential change in the teacher's probability of turnover if they primarily teach STEM, relative to their elementary colleagues, for every $10,000 increase in their inflation-adjusted total salary. In other words, if salary is a significant factor of Kansas teacher turnover, and $\tilde{\beta}_{11}$ is significantly different from zero, an increase in the inflation-adjusted total salary is associated with different differences in the teacher's turnover outcome depending on what subject area categories they teach in.

Robustness checks

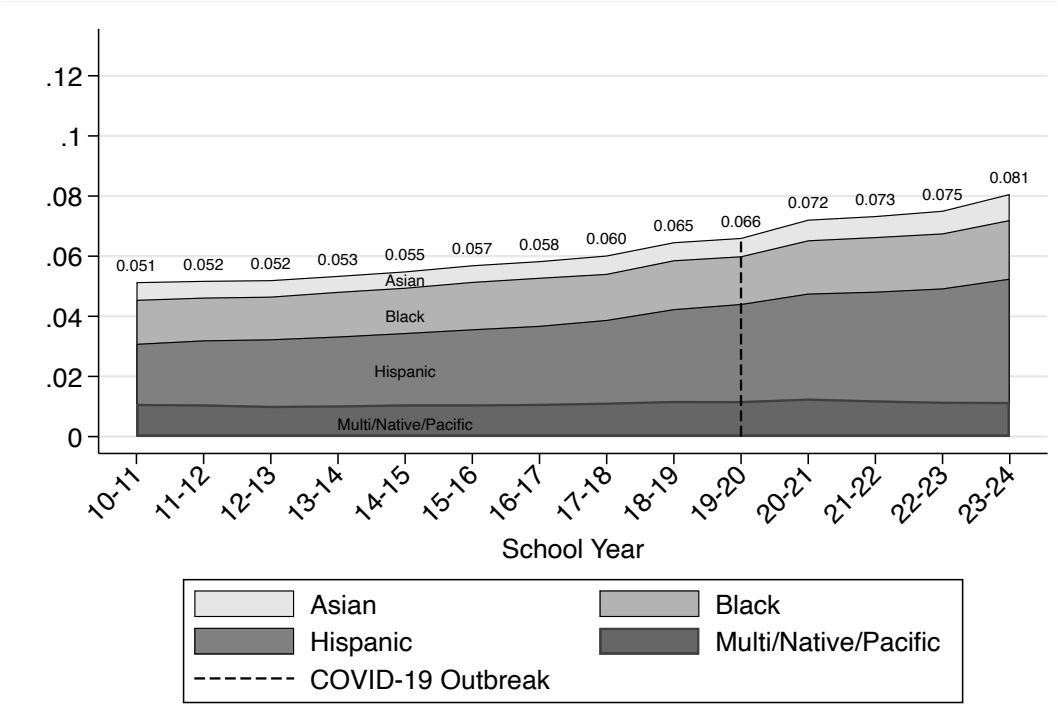
For robustness checks, all the LPMs for RQ2 and RQ3 are (re)estimated with logistic regression (Appendix Table D1). Also, since teacher salary is primarily determined at the district level and compensation policies may vary over time, I replicated RQ3's models with district-by-year fixed effects (Appendix Table D2).

The robustness check results are substantively similar to the main analysis.

Chapter 4 - Results

Kansas teacher workforce

To put the findings in context, I begin by describing the Kansas teacher workforce and their working conditions (i.e., school factors, and external/policy factors) over the past 15 years. First, Kansas teachers are majority women, accounting for about 76.2% of the workforce (Appendix Table C1). There has been a slight increase in the share of young teachers (under 30 years old) in the workforce, from 11.6% in 2012-2013 to 16.7% in 2022-2023. In contrast, the share of teachers over 65 years old has substantially declined, from 6.9% in 2012-2013 to just 1.4% in 2022-2023. Notably, while the Kansas teacher workforce remains predominantly White (93.8%), the share of teachers of color has increased, from 5.1% in 2010-2011 to 8.1% in 2023-2024 (Figure 3). The most notable increase is among Hispanic teachers, specifically from 2% in 2010-2011 to 4.1% in 2023-2024.



Note: Line labels indicate total annual shares of teachers of color.

Figure 3. Annual shares of teachers of color in the Kansas teacher workforce

As for qualifications, echoing the age patterns, the annual share of novice educators among Kansas teachers, those began the school year with three or less years of teaching experience, has also slightly increased, from 18.2% in 2010-2011 to 19.9% in 2023-2024. However, the share of STEM-certified teachers in the workforce has decreased from 16.6% in 2010-2011 to 13.7% in 2023-2024. The share of CTE-certified teachers has been stable, averaging about 5%, while the share of SPED/ESOL-certified teachers has also declined, from 23.2% in 2010-2011 to only 18.2% in 2023-2024. Relatedly, the share of graduate degree holders among Kansas teachers has decreased, from 37.9% in 2010-2011 to 32.0% in 2019-2020, despite slightly rising back to 33.1% in 2023-2024.

Regarding teaching categories, about 43.3% of the Kansas teacher workforce are non-SPED/ESOL elementary teachers, which has been stable over the past 15 years. About 3.9% of the workforce are non-elementary, non-STEM, CTE teachers. Meanwhile, the share of STEM teachers slightly increased from 13.5% in 2010-2011 to 16.0% in 2016-2017 but dropped back to 14.9% in 2023-2024. Notably, the share of SPED/ESOL teachers has notably declined, from 11.7% in 2010-2011 to 9.2% in 2023-2024.

In terms of school and student contexts, 26.1% of Kansas teachers serve in city schools, 15.7% teach in suburban schools, while the majority, 58.2%, are employed in rural/town schools. About 48% of the students in their school are female, and 49.2% are eligible for FRPL. Notably, students of color rates have been increasing, from 31.0% in 2010-2011 to 37.9% in 2023-2024.

With respect to compensation, Kansas teachers' unadjusted total salary, including base salary and fringe benefits, has been increasing, from about $50,500 a year in 2010-2011 to $63,500 a year in 2023-2024 (Figure 4). Nevertheless, once adjusted for inflation, their salaries

have been stagnating. The inflation-adjusted total salaries fluctuated between $68,000 and $70,000 during the period from 2010 to 2021, then steeply dropped to $63,500 in 2023-2024.

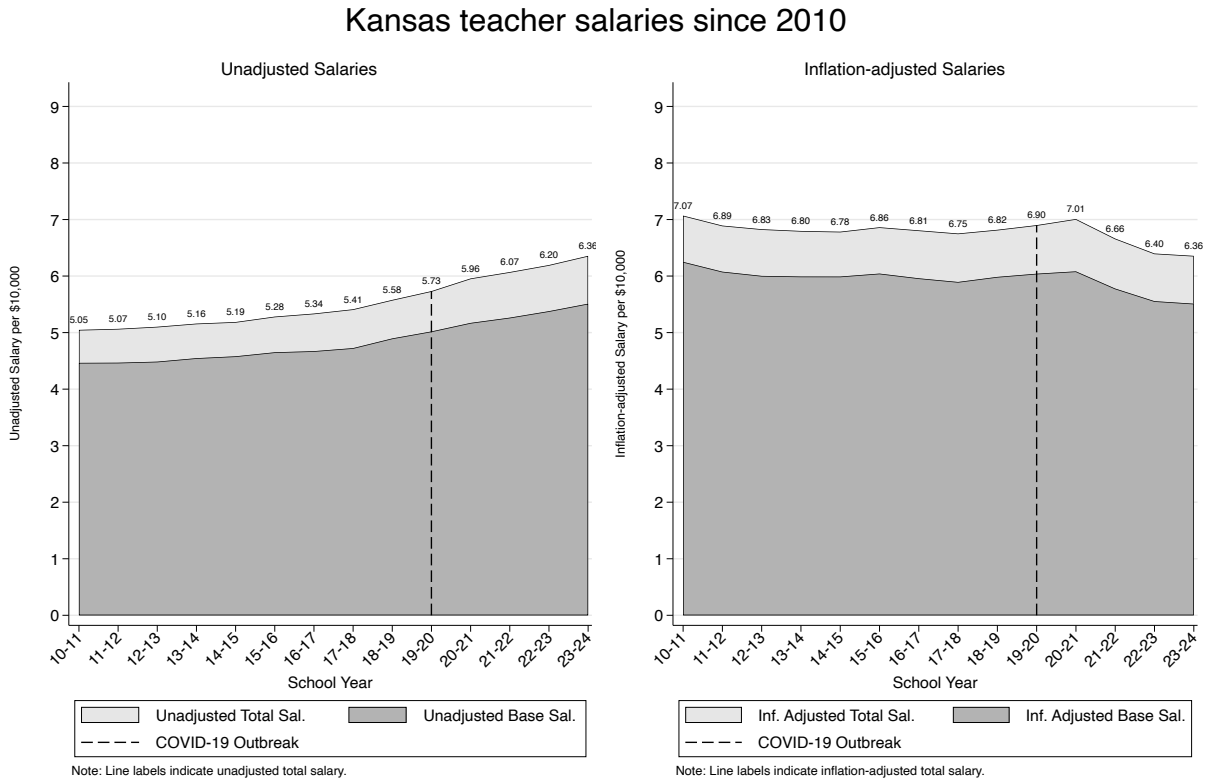


Figure 4. Kansas teacher unadjusted and inflation-adjusted salaries since 2010

RQ1 - The extent to which Kansas teachers turned turnover

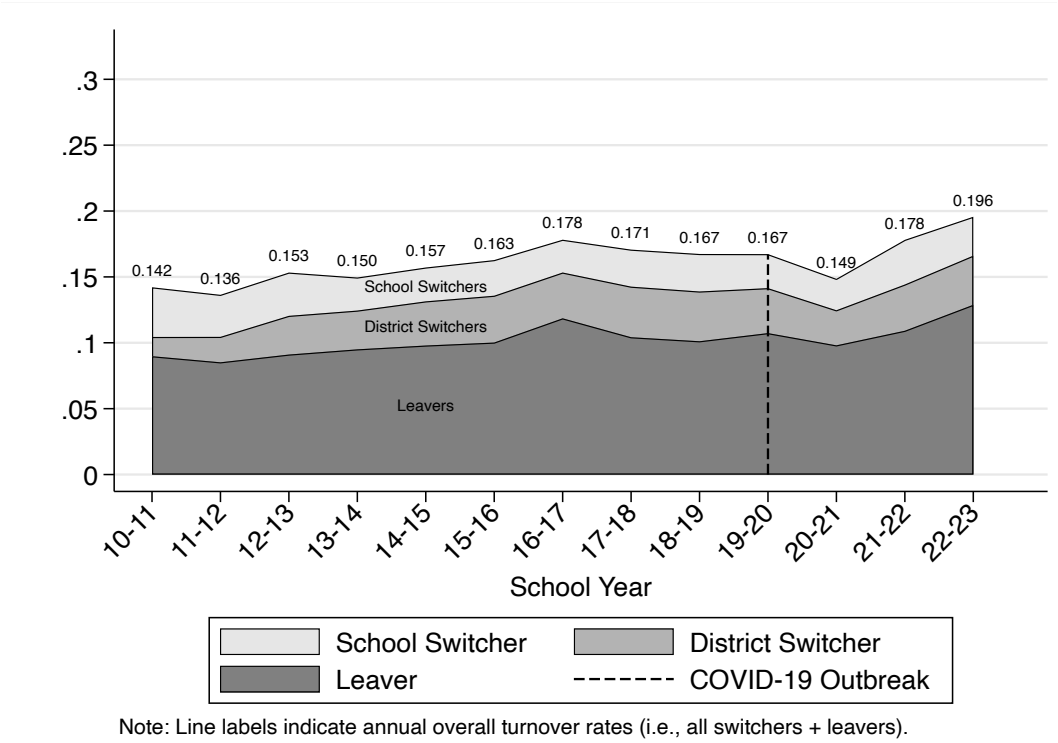
The overall turnover rate among Kansas teachers over the past 15 years is about 16.2% (Table 1). This includes 2.9% teachers switching schools in their district, 3.1% switching districts, and 10.2% teachers leaving the state's public elementary and secondary schools.

Table 1. Kansas teacher pooled turnover rates from 2010 through 2024

	Pooled
Turnover	0.162
School Switcher	0.029
District Switcher	0.031
Leaver	0.102
Observations	457,346

Note: The full set of year-to-year and pooled descriptive statistics is provided in Appendix Table C1.

As for year-to-year trends, Kansas teachers' overall turnover rate was 14.2% in 2010-2011, rose to 17.8% in 2016-2017, and reached 19.6% in 2022-2023, the highest level since 2010 (Figure 5). It is worth noting that teacher turnover in Kansas took a dip in 2020-2021, the school year after the pandemic outbreak in March, 2020, which is expected given the challenging economic and labor market conditions during that time, and consistent with evidence from other states (e.g., Bacher-Hicks et al., 2023; Goldhaber & Theobald, 2023).



Note: Line labels indicate annual overall turnover rates (i.e., all switchers + leavers).

Figure 5. Kansas teacher turnover since 2010

The largest group among turned over teachers has been leavers. About 2.9% and 3.1% teachers in Kansas switched schools and districts within the state, respectively, while 10.2% left the state's public elementary and secondary school system. Relatedly, only 15.7% of these leavers returned to the school system within three years (Appendix Table C1), while the rest of them, about 8.4% of the overall workforce, were long-term leavers.

In summary, the data suggest turnover among Kansas teachers has becoming more challenging over time, especially since the COVID-19 pandemic. The majority of the turned over teachers left the state's school system, and most of them did not return within three years.

RQ2 - Turnover among teacher, school, and student contexts

Among teaching categories, SPED/ESOL teachers turned over the most often, at 21.2%, followed by (non-STEM) CTE teachers, with 17.1%, while elementary, STEM, and other non-elementary teachers turned over at about 15.6%, 15.5%, and 15.9%, respectively (Figure 6).

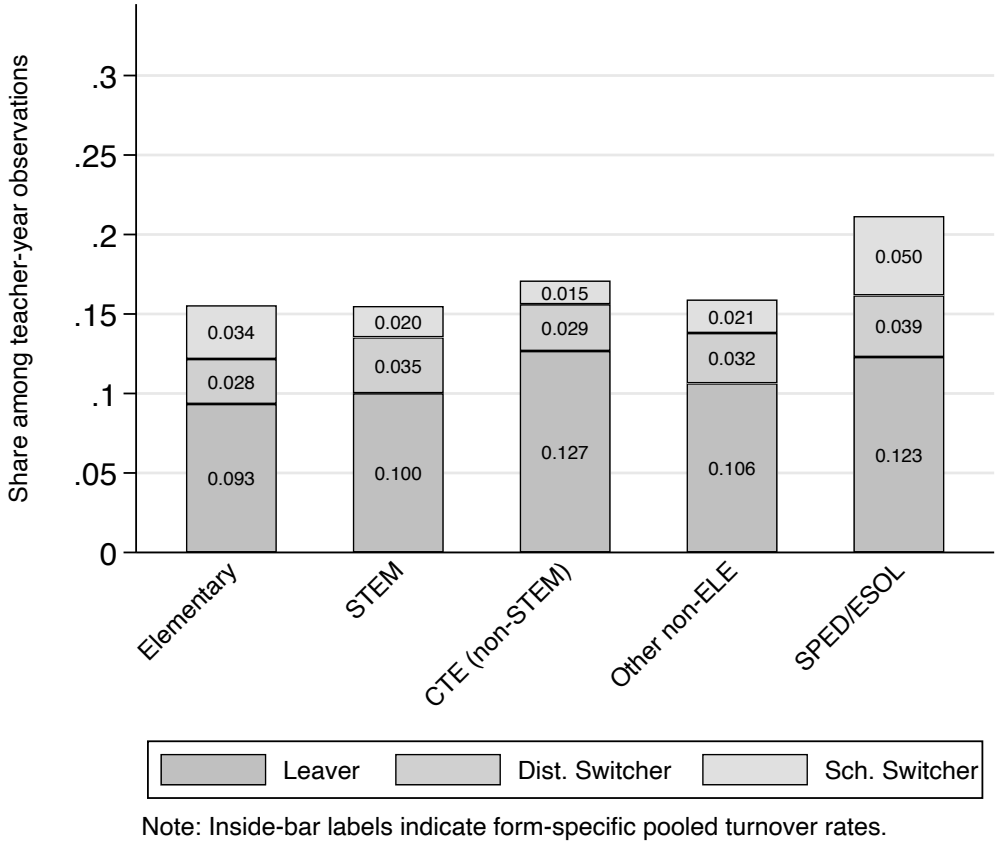


Figure 6. Pooled turnover rates by teaching category

Similar to the patterns observed in the overall teacher workforce, the majority of the teachers' departures was in the form of leaving, regardless of their teaching category. CTE teachers left Kansas public elementary and secondary schools with the highest frequency, at

12.7%, closely followed by SPED/ESOL teachers, with 12.3%. Notably, SPED/ESOL teachers also switched districts and schools the most often, with 3.9% district switching and 5.0% school switching. After SPED/ESOL, STEM teachers switched districts with the highest frequency, while elementary teachers are observed switching schools the most often.

Among locale settings, teachers employed in city schools turned over the most often, at 17.7%, followed by rural/town educators, with 16.0% (Figure 7). Meanwhile, teachers serving schools in the upper halves by percent of minoritized students (i.e., high-minoritized) turned over more frequently compared to their colleagues working in schools with more White students (17.1% vs. 14.8%). Similarly, teachers serving schools in the upper halves by percent of students eligible for FRPL (i.e., high-impoverished) departed at a higher rate relative to their counterparts in more affluent schools (17.7% vs. 14.8%).

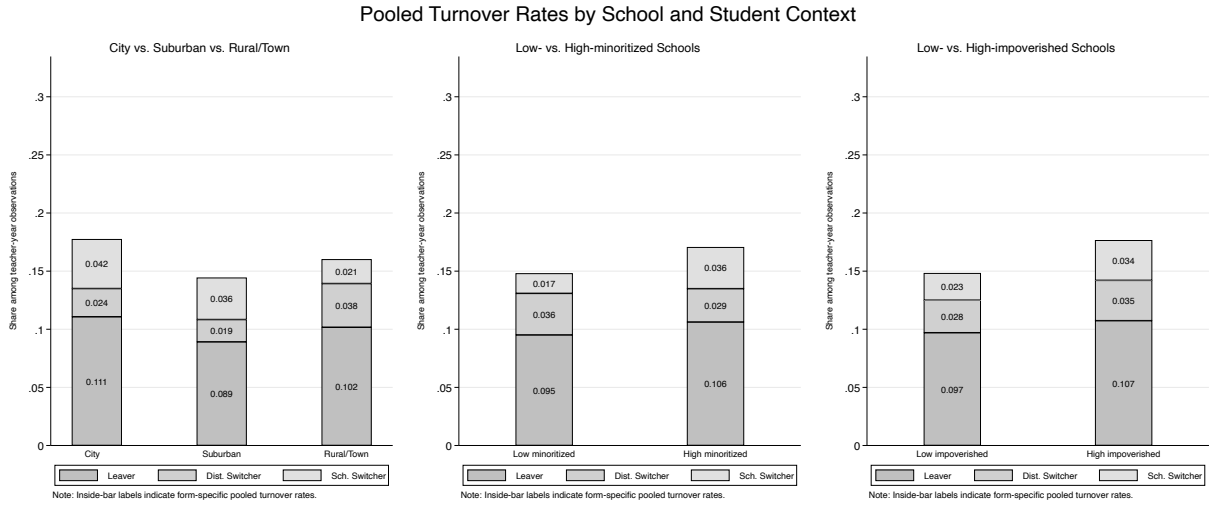


Figure 7. Turnover by locale, and between low- and high-minoritized/impoverished schools

Examining their turnover forms, while leaving remains the highest-rate turnover form across locale settings and student populations, there are some notable patterns among switchers. First, teachers switched schools the most often in city setting, with 4.2%, compared to other locales, while rural/town teachers tended to switch districts with the highest rate, relative to their

city and suburban colleagues. Teachers serving low-minoritized schools also tended to switch districts more frequently than their counterparts working in high-minoritized schools. In contrast, high-minoritized school teachers tended to switch schools at a higher rate compared to low-minoritized school teachers. Importantly, teachers employed in high-impoverished schools turned over with higher rates in all forms relative to their colleagues in more affluent contexts. It is worthy to note that rural/town school teachers in Kansas also tended to serve low-minoritized student populations, while city schools tended to enroll higher percent of students of color (Appendix Table C2), which helps explain the overlapping patterns between turnover among locale settings and students' racial compositions.

Further examining differences in turnover across teaching categories, I find STEM teachers are 2.0 percentage points significantly more likely to turn over compared to elementary teachers (Table 2). In contrast to the descriptive analysis, CTE teachers are not more or less likely to turn over relative to their elementary colleagues. Meanwhile, SPED/ESOL teachers are 4.4 percentage points significantly more likely to turn over compared to (non-SPED/ESOL) elementary teachers.

Table 2. Kansas teacher turnover regression by teacher, school, and student context

	Overall Turnover	School Switcher	District Switcher	Leaver
STEM	0.0203**	-0.0022	0.0139**	0.0136**
	(0.0030)	(0.0024)	(0.0017)	(0.0026)
CTE (non-STEM)	0.0076	-0.0064**	0.0066**	0.0076
	(0.0057)	(0.0022)	(0.0023)	(0.0052)
Other non-ELE	0.0109**	-0.0055*	0.0095**	0.0089**
	(0.0029)	(0.0024)	(0.0013)	(0.0020)
SPED/ESOL	0.0440**	0.0131**	0.0118**	0.0304**
	(0.0050)	(0.0028)	(0.0024)	(0.0037)
City School	0.0095	0.0035	-0.0037+	0.0110**
	(0.0061)	(0.0044)	(0.0021)	(0.0040)
Suburban School	-0.0065	-0.0003	-0.0024	-0.0046
	(0.0050)	(0.0031)	(0.0017)	(0.0035)
High Minoritized	0.0103**	0.0074**	0.0007	0.0042
	(0.0034)	(0.0019)	(0.0016)	(0.0027)

High Impoverished	0.0177**	0.0103**	0.0049**	0.0071**
	(0.0034)	(0.0026)	(0.0012)	(0.0023)
Inf-adj Total Salary per $10K	-0.0118**	-0.0031**	-0.0081**	-0.0044**
	(0.0012)	(0.0007)	(0.0009)	(0.0013)
Rel. Urbanicity (percentile)	0.0004*	0.0007**	-0.0002**	0.0001
	(0.0002)	(0.0001)	(0.0001)	(0.0001)
Observations	425210	368474	369541	399661

Note: + p < 0.10, * p < 0.05, ** p < 0.01. County- and year-fixed effects are employed. District-level clustered standard errors are in parentheses. The full set of regression estimates is provided in Appendix Table C4.

The regression analysis indeed uncovers more nuances in CTE teacher turnover relative to the descriptive analysis. Specifically, CTE teachers were significantly more likely to turn over compared to elementary teachers in the regression with only the teachers' teaching category ($\boldsymbol{Ttype'_{isdct}}$) (Appendix Table C3), reflecting the descriptive results. However, once teacher covariates were added (i.e., the first set of $\boldsymbol{TScov'_{isdct}}$), the difference between CTE and elementary teacher turnover was no longer significant and remained so while other covariates being added to the equation. Relatedly, the model selection process showed adding these various sets of covariates and fixed effects strengthened the robustness of the estimates, either by explanatory powers or information criteria, compared to models with less controls.

With respect to specific turnover forms, STEM teachers are also significantly more likely to switch districts, as well as significantly more likely to depart as leavers relative to elementary teachers. Meanwhile, CTE teachers are significantly less likely to switch schools, but significantly more likely to switch districts compared to their elementary colleagues. Notably, SPED/ESOL teachers are significantly more likely to turn over in all forms compared to elementary educators, with 1.3, 1.2, and 3.0 percentage points more likely to switch schools, switch districts, and leave the state's school system compared to their elementary colleagues.

In terms of school urbanicity, teachers employed in city schools, or schools located in a principal city, are not more or less likely to turn over compared to their colleagues serving in rural/town schools. This is inconsistent with the descriptive statistics, also likely due to controls,

as the turnover difference between city and rural/town teachers remained significant until the district's relative urbanicity percentile and fixed effects are included in the model (Appendix Table C3). However, even with such controls, city school teachers are still 1.1 percentage points significantly more likely to depart as leavers relative to rural/town school teachers.

Relatedly, teachers employed in districts within a higher percentile of relative urbanicity, as in, the district with higher levels of community asset availability, accessibility, population density, and developed land, are significantly more likely to turn over, compared to their colleagues serving in relatively less urbanized areas. Collectively, these estimates suggest it is not only the location of the school (e.g., whether being located inside or outside of a city area), but also the relative urbanicity of the district's community that matter to teacher retention. Taking a closer look, teachers serving in more relatively urbanized school districts are more likely to switch schools within the district, but less likely to transfer out of the district, matching the patterns observed among the traditionally categorized locale settings.

Regarding student contexts, teachers serving high-minoritized schools are 1.0 percentage points significantly more likely to turn over compared to their colleagues working in schools with more White students. While they are only marginally more likely to leave the state's school system, they are significantly more likely to switch schools. Most notably, teachers serving high-impoverished schools are 1.8 percentage points significantly more likely to turn over compared to their counterparts in more affluent schools, across all forms and especially as school switchers.

Finally, though serving as control variables for the analysis of RQ2, salary significantly explains turnover variations among Kansas teachers. In particular, a $10,000 increase in the teachers' inflation-adjusted total salary is significantly associated with 1.2 percentage point decrease in the probability of overall turnover in the Kansas teacher workforce, including 0.8 and

0.4 percentage point reduction in the probability of district switching and departure from the state's school system.

In summary, the analysis of RQ2 suggests there are significant variations among turnover patterns by teacher, school, and student contexts in Kansas, thereby emphasizing the complexity of Kansas teacher turnover. The findings that STEM teachers and teachers serving in city schools are significantly more likely to turn over also reflect the industrial dynamics of the Kansas context. Meanwhile, the fact that Kansas teachers are more likely to switch schools, especially from high-minoritized and high-impoverished schools, suggests there are likely disparities among same-district schools in the state that correlate with the teachers' mobility patterns. It also appears that such disparities are more pronounced in more urbanized areas, including those not located within principal cities, per the significance of the local community's percentile of services and amenities. Lastly, the results suggest compensation, as in the sum of salary and benefits, remains a significant factor of turnover among Kansas teachers, regardless of the turnover form.

RQ3 - Turnover and salary differential associations by teacher type

Interacting the teacher's annual total salary and their teaching category, I find salary is significantly and differentially associated with turnover (Table 3). In particular, a $10,000 increase in the inflation-adjusted total salary is significantly and differentially associated with the reductions in the probability of STEM and SPED/ESOL teachers' overall turnover compared to the change in the probability of overall turnover among non-SPED/ESOL elementary teachers. As for CTE and other non-elementary teachers, the differential returns by salary and teacher type are not statistically significant to their overall turnover relative to elementary teachers, but are significant to their probabilities of school switching and leaving the state's school system.

Table 3. Turnover and salary differential associations by teacher type

	Overall Turnover	School Switcher	District Switcher	Leaver
Inf-adj Total Salary per $10K	-0.0085**	-0.0046**	-0.0071**	-0.0002
	(0.0011)	(0.0010)	(0.0010)	(0.0011)
STEM	0.0950**	-0.0094+	0.0286**	0.0917**
	(0.0109)	(0.0051)	(0.0072)	(0.0085)
CTE (non-STEM)	0.0031	-0.0286**	0.0138	0.0143
	(0.0154)	(0.0056)	(0.0110)	(0.0130)
Other non-ELE	0.0254**	-0.0277**	0.0161**	0.0380**
	(0.0091)	(0.0041)	(0.0053)	(0.0076)
SPED/ESOL	0.0983**	0.0129	0.0281*	0.0956**
	(0.0138)	(0.0095)	(0.0137)	(0.0118)
STEM # Inf-adj Tot. Sal./$10K	-0.0110**	0.0012	-0.0022*	-0.0115**
	(0.0016)	(0.0009)	(0.0009)	(0.0012)
CTE (non-STEM) # Inf-adj Tot. Sal./$10K	0.0003	0.0033**	-0.0011	-0.0014
	(0.0022)	(0.0009)	(0.0014)	(0.0019)
Other non-ELE # Inf-adj Tot. Sal./$10K	-0.0024+	0.0033**	-0.0010	-0.0045**
	(0.0014)	(0.0007)	(0.0007)	(0.0011)
SPED/ESOL # Inf-adj Tot. Sal./$10K	-0.0081**	0.0001	-0.0024	-0.0097**
	(0.0019)	(0.0013)	(0.0020)	(0.0016)
Observations	425210	368474	369541	399661

Note: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$. County- and year-fixed effects are employed. District-level clustered standard errors are in parentheses. The full set of regression estimates is provided in Appendix Table C5.

To further illustrate how the association between total salary and turnover is differentiated by teaching category, I compute and plot the marginal differences for all the identified teacher types below (Figure 8). Accordingly, the reductions in the probabilities of STEM and SPED/ESOL teachers' overall turnover per salary increase are more pronounced compared to the likelihoods of overall turnover among (non-SPED/ESOL) elementary, (non-STEM) CTE, and other non-elementary teachers. This is also the case for the probabilities of leaving the state's school system among STEM and SPED/ESOL teachers compared to their elementary, CTE, and other non-elementary colleagues. Relatedly, elementary teachers are significantly more sensitive to salary variations in terms of school switching compared to CTE and other non-elementary educators.

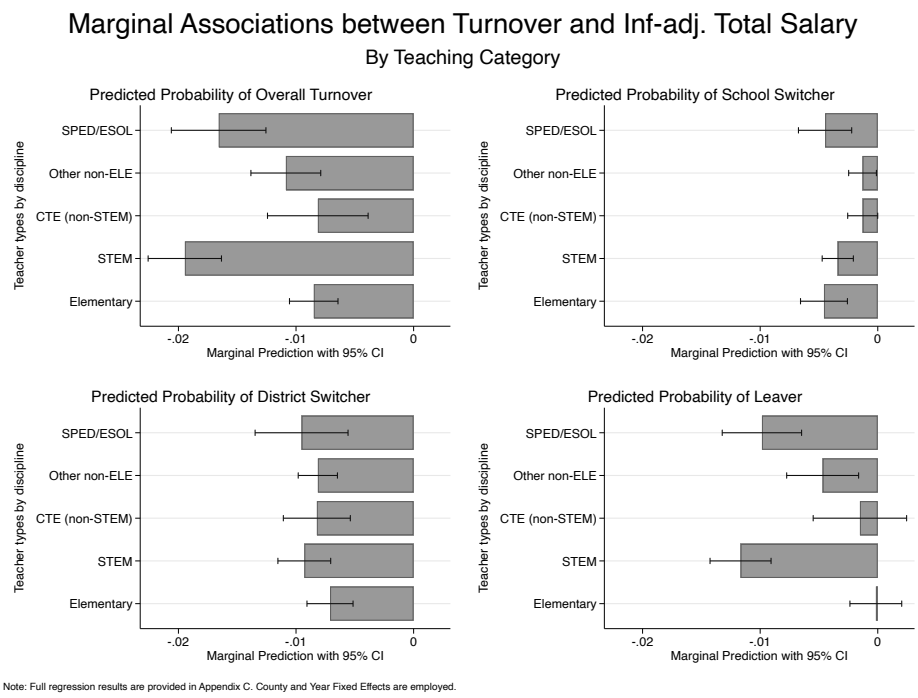


Figure 8. Salary differential associations with turnover by teacher type

In summary, the analysis of RQ3 dives deep into the association between turnover among Kansas teachers and their annual total salary, as in the sum of base salary and fringe benefits. While salary is a significant factor of Kansas teacher turnover, the association between salary and turnover is significantly differentiated by the teachers' teaching category. I find the reductions in the probabilities of overall turnover among STEM and SPED/ESOL teachers are significantly more pronounced per increase in salary, compared to their colleagues of other disciplines. Most importantly, differential returns by salary are the most pronounced when it comes to teachers leaving Kansas public schools, further emphasizing nuances in Kansas teacher turnover and suggesting potential targeted strategies for Kansas teacher retention.

Chapter 5 - Discussion and Conclusion

The Kansas teacher workforce and turnover

In this study, I began by describing the Kansas teacher workforce: Kansas teachers are majority women, and predominantly White. Although there has been an increase of teachers of color, especially among Hispanic teachers, the workforce remains stagnated in terms of teacher diversity relative to student diversity. I also find declines in STEM, CTE, and SPED/ESOL certifications among Kansas teachers over time, as well as the share of teachers holding graduate degrees. Last, but certainly not least, I find Kansas teacher salaries have substantially failed to keep up with inflation over the past three years. These preliminary findings suggest a need for Kansas to consider further diversifying their teaching force, encouraging teachers to obtain certifications and/or continue to enhance their professional specialties, and matching teacher salaries to the changing economic landscape of the post-COVID-19 era, as these elements are critically important to student learning and the sustainability of school systems (Darling-Hammond, 2000; Grissom et al., 2016; Nguyen et al., 2020; Redding, 2019).

In terms of the first research question, I addressed the extent to which Kansas teachers turned over in the past 15 years. I find Kansas teachers turned over at a rate that is comparable to the national average, which is about 16%, including 8% teachers transferring across schools, and 8% teachers leaving the profession (Taie & Lewis, 2023). However, the majority of turned over teachers left the state's public elementary and secondary school system, and most of them departed for long terms. Moreover, Kansas teacher turnover has substantially increased over the past three years since the COVID-19 pandemic, reaching a decade-high level at almost 20% teachers turned over by the end of 2022-2023. This sustained turnover in the workforce certainly adds challenges to the state's teacher staffing issues (Nguyen et al., 2024), as well as posing

threats to student learning and the stability of Kansas schools (Henry & Redding, 2020; Sorensen & Ladd, 2020).

Turnover across schools and student contexts

Addressing RQ2, I observe the highest turnover rates in city schools and schools serving the higher halves of students of color and poverty in the state. While city school teachers are not more or less likely to turn over compared to rural/town school teachers after controlling for the relative urbanicity of the district's local community, they are still significantly more likely to leave the state's school system. This suggests once the local community offers alternative employments, like in city areas, teachers are at the highest risk of turning over. This reflects recent surveys by the Educators Perceptions & Insights Center (EPIC), where Kansas teachers reported concerns over the societal status of the teaching profession, limited salary growth potentials, and limited incentives to advance their own education (Church & Simmering, 2023).

Moreover, teachers employed in districts that are relatively urbanized, including those not situated in city areas, are significantly more likely to turn over compared to those serving less urbanized communities, especially in the form of school switching. This adds an insight to the unsettled concern of the current literature regarding teacher turnover across geographies (Nguyen et al., 2020), echoing works highlighting teacher mobility across geographically diverse contexts are more complex than a mere urban/rural distinction (Nguyen, 2020a; Rhinesmith et al., 2023). Furthermore, I speculate that in districts that are not too remotely rural nor excessively urban, perhaps with some availability of services and amenities, which tend to have more than a few schools, there are disparities in working conditions across schools that are linked to teacher turnover. These non-city but somewhat urbanized communities may offer supportive climates that encourage teachers to remain (Friesen, 2016), but not necessarily retain them in the school.

Indeed, I do find Kansas teachers significantly more likely to turn over from schools serving higher percent of minoritized and impoverished students compared to their colleagues working with more White students and students from relatively more affluent families. While low-income school teachers are significantly more likely to turn over in all forms, high-minoritized school teachers are particularly more likely to switch schools. This supports my speculation that there are disparities in teacher working conditions in Kansas, even among schools within the same district, as prior works have consistently found schools serving higher percent of marginalized students tend to have teacher working conditions that are worse than those serving students from more advantaged backgrounds (Bettini et al., 2016; Nguyen, 2021).

Moreover, the fact that teachers employed in high-minoritized schools are more likely to switch to another school in the same district seems to suggest there is likely some extent of racial desegregation among Kansas schools. It is noteworthy that schools serving the higher half of students of color are often located in the state's cities or relatively urbanized areas, but this switching pattern remains significant even after accounting for both the school's traditional locale category and the district's relative urbanicity. Anecdotally, it may not even be the physical conditions of the school, but the local perceptions and narratives regarding the marginalized students the school serves that are associated with teacher attrition. While Kansas teachers are predominantly White and the workforce continues to stagnate relative to the increasing student diversity, these dynamics further emphasize the critical need for Kansas school districts to diversify their teachers as well as consider equitably allocating resources among their schools.

Turnover among teacher types and the association with salary

As part of the analysis of RQ2, I observe the highest turnover rates among SPED/ESOL and (non-STEM) CTE teachers compared to teachers teaching (non-SPED/ESOL) elementary

and other subject categories. However, while the turnover difference between SPED/ESOL and elementary teachers remained significant after the controlling for other covariates, consistent with the literature (Billingsley & Bettini, 2019; Nguyen et al., 2020), CTE teachers are not more or less likely to turn over relative to their colleagues in elementary schools. Nevertheless, it is not totally clear from the data as to whether CTE teacher turnover is insignificant, as their group size is much smaller relative to the rest of the sample. It is worth pointing out that over 96% CTE teachers in Kansas are White (Appendix Table C2), the highest rate among teachers of all teaching categories, but they often serve a higher percent of underachieving and underrepresented students (Anglum et al., 2023). Further research is therefore necessary to understand the turnover patterns of CTE teachers, as well as to examine if their turnover is associated with the mismatch between their and the students' racial backgrounds.

Although being observed with turnover rates that are comparable to elementary and other non-elementary teachers, STEM educators are significantly more likely to turn over after accounting for the control factors, especially in the forms of district switching and leaving the state's school system. This reflects some extent of the Kansas labor market, which features industrial sectors such as agriculture, aerospace, manufacturing, energy, and animal sciences, where teachers of mathematics, natural sciences, and computer science can conveniently transfer their knowledge and skills over. In fact, teachers are paid a lot less than professional workers with comparable qualifications (García & Weiss, 2019a), and STEM teachers in particular receive lower salaries than the average wage of workers in STEM occupations (U.S. Bureau of Labor Statistics, 2024). Combined with the concerned societal status of the teaching profession, it appears even more challenging for Kansas to recruit and retain STEM educators for their classrooms, given its labor market circumstances.

Echoing the findings of RQ2, my analysis of RQ3 finds STEM and SPED/ESOL teacher mobilities are significantly more sensitive to salary variations compared to their colleagues teaching other categories. These estimates remained robust even with the district-by-year fixed effects included (Appendix Figure D1), and are consistent with recent findings reported in the literature (e.g., Candelaria et al., 2024). To put this in context, a $10,000 adjusted salary increase predicts 1.2 percentage point turnover reduction in the overall Kansas teacher workforce, but 1.9 and 1.7 percentage point decreases in the probabilities of turnover if it was for STEM and SPED/ESOL, respectively. These are in fact meaningful numbers, because one percentage point reduction in turnover from the latest school year, 2023-2024, with about 32,000 individual teachers, could have helped the state retain 320 positions, 18% of the total reported teacher vacancies for spring 2024 (1,810 positions), and half of the vacancies due to teacher supply (640 positions) (Kansas State Department of Education, 2024b).

Implications for policy and practice

Recently, Kansas has initiated several incentive programs that aim to address the state's teacher staffing challenges. These include the Kansas Computer Science Educator Scholarship, which provides a one-time $1,000 award for pre- and in-service seeking credentials in computer science education; the Kansas Education Opportunity Scholarship, assisting first-generation college students and/or dependents of teachers and paraprofessionals in Kansas with their first undergraduate degree; and, the Kansas Teacher Service Scholarship, a merit-based service obligation scholarship program supporting pre- and in-service teachers in hard-to-fill subject areas and locations (The Kansas Board of Regents, n.d.). More particularly, the Kansas Teacher Service Scholarship targets subject areas including elementary education, English language arts, mathematics, science, and special education, and school districts including USD 500, Kansas

City, USD 501, Topeka, USD 259, Wichita, and Kansas State Board of Education Districts five, seven, and nine, thereby receivers of financial assistance are obligated practice teaching in these identified subject areas and schools within six months of licensure for a time that depends on the extent to which they were supported (The Kansas Board of Regents, 2024).

As I highlighted substantial variations in retention patterns among teacher, school, and student contexts, Kansas policy makers can leverage my findings to expand their existing incentive programs to further address their teacher staffing challenges, including expansion to other areas of the state, especially among marginalized communities, as well as providing support for teachers, such as induction or mentoring, once they begin teaching in these targeted subject areas and locations. This is because the existing programs incentivize individuals to become teachers, but fall short of encouraging their retention, which is critical given the increasing teacher turnover in the state, and that novice teachers are at the highest risk of resigning from the school and the profession (Nguyen et al., 2020; Ronfeldt & McQueen, 2017).

Moreover, Kansas may need to further consider targeted policies to recruit diverse teachers for their teaching force. With the growing student diversity relative to teacher diversity in Kansas, diversifying the teacher workforce may help boost teacher retention in the state, in addition to enhancing student academic achievement and behavioral outcomes (Joshi et al., 2018; Redding, 2019; Scott et al., 2023). Kansas has recently initiated an alternative, grow-your-own type, teacher pathway, the Kansas Registered Teacher Apprenticeship Model, which is intended to allow school districts to actively invest in the development of their teaching forces with talents from within the local community (Kansas State Department of Education, 2024a). Some studies have found such alternative routes could create opportunities for schools in marginalized communities to recruit teachers who share the identity and are connected with community

members, thereby encouraging them to remain in the classroom (Gist, 2022). Others suggest such programs may help with teacher staffing in schools serving with more low-income, low-performing, and racially underrepresented students (An & Koedel, 2021). Nevertheless, researchers have also cautioned the limitations of grow your own programs, especially that little has been known about how effective these programs have been in terms of addressing teacher staffing challenges and diversifying the workforce (Edwards & Kraft, 2024). Given the unique context of Kansas and substantial variations across teacher types and school and student contexts, further research is needed to evaluate whether the state's efforts are helping schools and districts provide equitable access to retained teachers among diverse student populations.

It is important to emphasize that the existing programs in Kansas are about teacher recruitment, and no program has been initiated to particularly address teacher attrition. As evident from my analysis, one potential strategy for Kansas is to incentivize teachers via compensations differentiated by teacher type and school and student contexts. Kansas' adjacent state, Missouri, has been pursuing a salary reform policy that creates pathways for within-district differential teacher pay (Senate Bill No. 727, 2024, p. 727). Research has shown salary increases in general could increase teacher retention, and targeted monetary incentives could be a feasible option for states and school districts per their cost effectiveness relative to across-the-board pay raises (Nguyen et al., 2020). One study, examining the statutory differential pay policy in Georgia (H.B. 280), found the program reduced the state's teacher attrition by about 18% (Bueno & Sass, 2019); which, given the 16.2% turnover rate and the workforce size of 32,000 teachers in Kansas, could mean retaining over 900 teachers a year. However, careful deliberation is still necessary as some studies found differential teacher compensations might attract certain types of teachers, but not others (Clotfelter et al., 2011; Strunk & Zeehandelaar, 2011). At the bottom

line, this area of policies remains underexplored, noting that Kansas teacher workforce differs from the research contexts in which prior works took place (e.g., California, Georgia, North Carolina), but it should be retained as a strong potential for consideration.

I must also emphasize that teacher salary has never been the single concern of the teacher workforce, but is often mistaken, and sometimes intentionally misused, as the sole solution to school staffing issues. This becomes evident when teachers voice their demands to the public, notably during teacher strikes. In fact, 60% of the school walkouts in the past decade demanded improvements in the school's resources, infrastructure, non-instructional staffing, and labor rights, while districts that experienced strikes often had comparable teacher compensations relative to those without a teacher strike; they tended to have larger student-teacher ratios, lower per-pupil expenditures, and often served larger shares of students of color, students in poverty, and ESOL students (Lyon et al., 2024). For example, teachers in the 2019 teacher strike in Los Angeles (LAUSD), the second-largest school district in the U.S., demanded, among others, smaller class size, increased support staff, special education support, green space and school campus improvements, standardize test reform, and charter school regulations (Swaak, 2019). However, the neoliberal LAUSD leadership at the time tried to frame narratives around the strike that the teachers only wanted more money, while the city leaders urged the teachers to narrow their proposal to "essential" items like pay and benefits (McAlevey, 2020). The six-day strike, which involved 60,000 people, including the 30,000 LAUSD teachers, along with parents, students, and other community members, ultimately ended with the teachers wining an expanded contract, achieving more equitable opportunities for their students and sustainable working conditions for themselves (McAlevey, 2020). This is to emphasize, once again, that salaries matter for teachers, but they are not a silver bullet for solving the problems of public education,

especially in the modern context with emerging influences of neoliberalism. Policy considerations aimed at sustaining the teacher workforce and providing students with equitable access to diverse, qualified, and retained teachers must seriously consider the varied factors and circumstances of teacher retention to deliver the positive results and to avoid perpetuating the existing gaps among diverse students.

The Kansas Constitution mandates equitable educational opportunities for all students (as upheld in Gannon v. Kansas, Daniel, 2016). This includes equitable access to diverse, qualified, and retained teachers. Fulfilling this constitutional obligation requires a collective effort from policymakers, educators, and the public.

References

An, Y., & Koedel, C. (2021). How do teachers from alternative pathways contribute to the teaching workforce in urban areas? Evidence from Kansas City. *AERA Open*, *7*, 233285842110269. https://doi.org/10.1177/23328584211026952

Anglum, J. C., Diemer, A. R., Ecton, W. G., & Nguyen, T. D. (2023). We need to know more about CTE teachers. *Phi Delta Kappan*, *104*(6), 18–23. https://doi.org/10.1177/00317217231161535

Anglum, J. C., Manion, A., & Varkey, S. (2024). Increasing minimum teacher salaries: Opportunities and drawbacks across geography and race. *Urban Affairs Review*, *60*(6), 1931–1955. https://doi.org/10.1177/10780874241237412

Bacher-Hicks, A., Chi, O. L., & Orellana, A. (2023). Two years later: How COVID-19 has shaped the teacher workforce. *Educational Researcher*, *52*(4), 219–229. https://doi.org/10.3102/0013189X231153659

Bartanen, B., & Grissom, J. (2019). School principal race and the hiring and retention of racially diverse teachers. *Annenberg Institute at Brown University*. http://edworkingpapers.com/ai19-59

Bettini, E. A., Crockett, J. B., Brownell, M. T., & Merrill, K. L. (2016). Relationships between working conditions and special educators' instruction. *The Journal of Special Education*, *50*(3), 178–190. https://doi.org/10.1177/0022466916644425

Billingsley, B. S. (1993). Teacher retention and attrition in special and general education: A critical review of the literature. *The Journal of Special Education*, *27*(2), 137–174. https://doi.org/10.1177/002246699302700202

Billingsley, B. S. (2004). Special education teacher retention and attrition: A critical analysis of the research literature. *The Journal of Special Education*, *38*(1), 39–55. https://doi.org/10.1177/00224669040380010401

Billingsley, B. S., & Bettini, E. (2019). Special education teacher attrition and retention: A review of the literature. *Review of Educational Research*, *89*(5), 697–744. https://doi.org/10.3102/0034654319862495

Borman, G. D., & Dowling, N. M. (2008). Teacher attrition and retention: A meta-analytic and narrative review of the research. *Review of Educational Research*, *78*(3), 367–409. https://doi.org/10.3102/0034654308321455

Bueno, C., & Sass, T. R. (2019). *The effects of differential pay on teacher recruitment and retention* (No. CALDER Working Paper No. 219-0519). Center for Analysis of Longitudinal Data in Education Research. https://files.eric.ed.gov/fulltext/ED595205.pdf

Candelaria, C. A., Nienstedt, L., Penner, E. K., Ainsworth, A. J., & Liu, Y. (2024). *Should they pay, or should I go? Differential responses to base salary increases* (EdWorkingPaper: 24-1003). https://edworkingpapers.com/ai24-1003

Chapman, D. W. (1983). A model of the influences on teacher retention. *Journal of Teacher Education*, *34*(5), 43–49. https://doi.org/10.1177/002248718303400512

Chen, A., & Murphy, R. (2022, April 28). Virginia schools look to fill over a thousand teacher vacancies. *NBC 12*. https://www.nbc12.com/2022/04/28/virginia-schools-look-fill-over-thousand-teacher-vacancies/

Church, B., & Simmering, L. (2023). *Kansas educator engagement & retention study*. Educator Perceptions & Insights Center. https://edu-epic.com/wp-content/uploads/2024/01/2024-Kansas-Teacher-Retention-Survey-State-Report.pdf

Clagg, M. S. (2002). *Why beginning teachers stay in the profession: Views in a Kansas school district* [Doctoral dissertation]. Wichita State University.

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2011). Teacher mobility, school segregation, and pay-based policies to level the playing field. *Education Finance and Policy*, *6*(3), 399–438. https://doi.org/10.1162/EDFP_a_00040

Daniel, K. (2016). Adequate and equitable education is a constitutional requirement under the Kansas constitution. Gannon v. State, 319 P. 3D 1196. *Rutgers University Law Review*, *68*(4), 1603–1622.

Darling-Hammond, L. (2000). Teacher quality and student achievement. *Education Policy Analysis Archives*, *8*(1). https://doi.org/10.14507/epaa.v8n1.2000

Darling-Hammond, L. (2010). *The flat world and education: How America's commitment to equity will determine our future*. Teachers College Press.

Darling-Hammond, L., Furger, R., Shields, P. M., & Sutcher, L. (2016). *Addressing California's emerging teacher shortage: An analysis of sources and solutions*. Learning Policy Institute. https://learningpolicyinstitute.org/product/addressing-californias-emerging-teacher-shortage

Dee, T. S., & Goldhaber, D. (2017). *Understanding and addressing teacher shortages in the United States*. The Brookings Institution. https://www.brookings.edu/research/understanding-and-addressing-teacher-shortages-in-the-united-states/

Dinerstein, M., Megalokonomou, R., & Yannelis, C. (2022). Human capital depreciation and returns to experience. *American Economic Review*, *112*(11), 3725–3762. https://doi.org/10.1257/aer.20201571

Edwards, D., & Kraft, M. A. (2024). *Grow Your Own teacher programs: What are they, and what can (and can't) they accomplish?* Brookings Institution. https://www.brookings.edu/articles/grow-your-own-teacher-programs-what-are-they-and-what-can-and-cant-they-accomplish/

Ewy, C. L. (2007). *The value of administrative behaviors: A comparative study of special education teachers and building administrators in Kansas* [Doctoral dissertation, Kansas State University]. K-State Research Exchange (K-REx).

Fowler, B. L. (1954). *Turnover of business teachers in the secondary schools of Kansas, 1952-1953* [Master Thesis, Kansas State Teachers College]. William Allen White Library.

Franco, M., & Patrick, S. K. (2023). *State teacher shortages: Teaching positions left vacant or filled by teachers without full certification*. Learning Policy Institute.

Friesen, S. A. (2016). *A qualitative case study of teacher retention in a rural secondary school* [Doctoral dissertation, Wichita State University]. Shocker Open Access Repository.

Garay-Huamán, A. N., & Irazábal-Zurita, C. (2021). Latinos in kansas city: The political economy of placemaking. *Journal of Planning Literature*, *36*(2), 131–154. https://doi.org/10.1177/0885412220969910

García, E., & Weiss, E. (2019a). *Low relative pay and high incidence of moonlighting play a role in the teacher shortage, particularly in high-poverty schools* (The Perfect Storm in the Teacher Labor Market). Economic Policy Institute. https://www.epi.org/publication/low-relative-pay-and-high-incidence-of-moonlighting-play-a-role-in-the-teacher-shortage-particularly-in-high-poverty-schools-the-third-report-in-the-perfect-storm-in-the-teacher-labor-marke/

García, E., & Weiss, E. (2019b). *The teacher shortage is real, large and growing, and worse than we thought* (The Perfect Storm in the Teacher Labor Market). Economic Policy Institute.
Gist, C. D. (2022). Shifting dominant narratives of teacher development: New directions for expanding access to the educator workforce through grow your own programs. *Educational Researcher*, *51*(1), 51–57. https://doi.org/10.3102/0013189X211049762
Goldhaber, D., Strunk, K. O., Brown, N., Naito, N., & Wolff, M. (2020). Teacher staffing challenges in California: Examining the uniqueness of rural school districts. *AERA Open*, *6*(3), 2332858420951833. https://doi.org/10.1177/2332858420951833
Goldhaber, D., & Theobald, R. (2016, September 22). Opinion: Sorting out the issues in the teacher shortage crisis. *The 74*. https://www.the74million.org/article/article-opinion-sorting-out-the-issues-in-the-teacher-shortage-crisis/
Goldhaber, D., & Theobald, R. (2023). Teacher attrition and mobility in the pandemic. *Educational Evaluation and Policy Analysis*, *45*(4), 682–687. https://doi.org/10.3102/01623737221139285
Green, P., Hamilton, M. L., & Hampton, J. K. (2005). Who stays in teaching and why? A case study of graduates from the University of Kansas' 5th-year teacher education program. In G. Hoban (Ed.), *The missing links in teacher education design* (pp. 153–167). Springer Netherlands.
Grissom, J. A., Nicholson-Crotty, J., & Keiser, L. (2012). Does my boss's gender matter? Explaining job satisfaction and employee turnover in the public sector. *Journal of Public Administration Research and Theory*, *22*(4), 649–673. https://doi.org/10.1093/jopart/mus004
Grissom, J. A., Viano, S. L., & Selin, J. L. (2016). Understanding employee turnover in the public sector: Insights from research on teacher mobility. *Public Administration Review*, *76*(2), 241–251. https://doi.org/10.1111/puar.12435
Guarino, C. M., Santibañez, L., & Daley, G. A. (2006). Teacher recruitment and retention: A review of the recent empirical literature. *Review of Educational Research*, *76*(2), 173–208. https://doi.org/10.3102/00346543076002173
Guthery, S., & Bailes, L. P. (2022). Patterns of teacher attrition by preparation pathway and initial school type. *Educational Policy*, *36*(2), 223–246. https://doi.org/10.1177/0895904819874754
Hanushek, E. A., Rivkin, S. G., & Schiman, J. C. (2016). Dynamic effects of teacher turnover on the quality of instruction. *Economics of Education Review*, *55*, 132–148. https://doi.org/10.1016/j.econedurev.2016.08.004
Hart, E. D. (1972). *Factors which tend to influence teacher attrition as reported by selected former educators in the States of Nebraska and Kansas* [Specialist in Education, University of Nebraska at Omaha]. Dr. C.C. and Mabel L. Criss Library.
Heffley, R. C. (1983). *Factors affecting teacher turnover in Kansas* [Doctoral dissertation]. University of Kansas.
Hendricks, M. D. (2014). Does it pay to pay teachers more? Evidence from Texas. *Journal of Public Economics*, *109*, 50–63. https://doi.org/10.1016/j.jpubeco.2013.11.001
Henry, G. T., & Redding, C. (2020). The consequences of leaving school early: The effects of within-year and end-of-year teacher turnover. *Education Finance and Policy*, *15*(2), 332–356. https://doi.org/10.1162/edfp_a_00274

Holme, J. J., Jabbar, H., Germain, E., & Dinning, J. (2018). Rethinking teacher turnover: Longitudinal measures of instability in schools. *Educational Researcher*, *47*(1), 62–75. https://doi.org/10.3102/0013189X17735813

Hower, R. K. (1963). *A study of teacher "turnover" in second class city high schools in Kansas, 1961-62* [Master Report, Kansas State University]. K-State Research Exchange (K-REx).

Ingersoll, R. M., & May, H. (2012). The magnitude, destinations, and determinants of mathematics and science teacher turnover. *Educational Evaluation and Policy Analysis*, *34*(4), 435–464. https://doi.org/10.3102/0162373712454326

James, J. (2021, December 20). Teacher shortage: Mississippi lacks 3000 certified teachers. *Mississippi Today*. https://mississippitoday.org/2021/12/20/mississippi-teacher-shortage-3000-teacher-vacancies/

Johnson, L. S. (2007). Teacher induction in Kansas City: State policy, district trends, and their implications. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2355031

Jones, T. E. (1967). *The effect of Title I on the Elementary and Secondary Education Act of 1965 on teacher shortage and salaries in Kansas schools* [Master Thesis, Kansas State Teachers College]. William Allen White Library.

Joshi, E., Doan, S., & Springer, M. G. (2018). Student-teacher race congruence: New evidence and insight from tennessee. *AERA Open*, *4*(4), 2332858418817528. https://doi.org/10.1177/2332858418817528

Kansas State Department of Education. (2012). *Educator Data Collection System and Licensed Personnel Report: Web application user manual*. https://www.ksde.org/Portals/0/TLA/Licensure/Licensure%20Documents/LPR-EDCS%20User%20Manualv2011-2012%20Updated.pdf

Kansas State Department of Education. (2016). *Kansas Commissioner of Education's Blue Ribbon Task Force on Teacher Vacancies and Supply. Final report*. Kansas State Department of Education. https://www.ksde.org/Portals/0/Communications/Publications/BRTF%20Final.pdf

Kansas State Department of Education. (2019). *Teacher vacancy and supply. Updated to the State Board: Initiatives, selected vacancy and licensed personnel report data*. Kansas State Department of Education. https://www.ksde.org/Portals/0/TLA/LPR/Board%20Report%20LPR%20Oct%202019_Final_Version.pdf?ver=2019-11-07-074533-590

Kansas State Department of Education. (2022, April). *Spring educator vacancy report: Update to the Board*.

Kansas State Department of Education. (2024a). *Kansas Registered Teacher Apprenticeship Model*. https://www.ksde.org/Agency/Division-of-Learning-Services/Teacher-Licensure-TL/Registered-Teacher-Apprenticeship

Kansas State Department of Education. (2024b, October 8). *Teacher vacancy and supply*.

Keeley, T. D. (1959). *A study of factors which contribute to teacher turnover in forty-nine selected high schools in Western Kansas* [Master Thesis, Fort Hays Kansas State College]. FHSU Scholars Repository.

Kells, P. P. (1982). *Kansas survey regarding attrition of special education personnel-Kansas Regent Institutions Special Project: Summary Report*. Kansas Board of Regents.

Lashier, W. S., & Ryoo, W. Y. (1984). A longitudinal study of the supply and demand for physics and chemistry teachers in Kansas. *Journal of Research in Science Teaching*, *21*(1), 17–26. https://doi.org/10.1002/tea.3660210103

Lee, A. (2022, June 16). Educator survey reveals statewide teacher shortage. *FOX21 News Colorado*. https://www.fox21news.com/news/educator-survey-reveals-statewide-teacher-shortage/

Lyon, M. A., Kraft, M. A., & Steinberg, M. P. (2024). The causes and consequences of U.S. teacher strikes. *NBER Working Paper Series*. https://doi.org/10.3386/w32862

Macdonald, D. (1999). Teacher attrition: A review of literature. *Teaching and Teacher Education*, *15*(8), 835–848. https://doi.org/10.1016/S0742-051X(99)00031-1

McAlevey, J. (2020). *A collective bargain: Unions, organizing, and the fight for democracy* (First edition). Ecco/an Imprint of HarperCollins Publishers.

McClure, C., & Reeves, C. (2004). *Rural teacher recruitment and retention: Review of the research and practice literature*. Appalachia Educational Laboratory.

McKnab, P. (1983). *Special education personnel attrition in Kansas, 1976 to 1982: A summary of attrition rates and analysis of reasons for quitting*. Kansas Board of Regents.

McKnab, P. (1992). *Attrition of special education personnel in Kansas from 1991-91 to 1991-92*. Kansas State Board of Education.

McKnab, P. (1993). *Attrition rates and the reasons for leaving of special education personnel in Kansas: 1991-92 to 1992-93*. Kansas State Board of Education.

McKnab, P. (1995). *Attrition rates of special education personnel in Kansas: 1993-94 to 1994-95*. Kansas State Board of Education.

McKnab, P. (2002). *Special education personnel attrition in Kansas for the school years of 2000-01 to 2001-02*. Kansas State Department of Education.

Miller, J. M., Youngs, P., Perrone, F., & Grogan, E. (2020). Using measures of fit to predict beginning teacher retention. *The Elementary School Journal*, *120*(3), 399–421. https://doi.org/10.1086/707094

Nance, E., & Calabrese, R. L. (2009). Special education teacher retention and attrition: The impact of increased legal requirements. *International Journal of Educational Management*, *23*(5), 431–440. https://doi.org/10.1108/09513540910970520

Nassar, I. (1989). *Kansas State University science and mathematics education graduates in terms of their undergraduate preparation, career choice, and the identification of factors contributing to teacher shortage and retention* [Master Thesis, Kansas State University]. K-State Research Exchange (K-REx).

National Center for Education Statistics. (2022, February 25). *NCES locale classifications and criteria*. https://nces.ed.gov/surveys/annualreports/topical-studies/locale/definitions

National Center for Education Statistics. (2023, July 31). *Documentation to NCES' Common Core of Data (CCD): Changes to CCD-assigned school and LEA levels*. https://nces.ed.gov/ccd/doc/11_Changes_SCH_LEA_Level_Assignments_7.31.2023.docx

Nelson, K. S., & Nguyen, T. D. (2023). Community assets and relative rurality index: A multi-dimensional measure of rurality. *Journal of Rural Studies*, *97*, 322–333. https://doi.org/10.1016/j.jrurstud.2022.12.025

Nguyen, T. D. (2020a). Examining the teacher labor market in different rural contexts: Variations by urbanicity and rural states. *AERA Open*, *6*(4), 233285842096633. https://doi.org/10.1177/2332858420966336

Nguyen, T. D. (2020b). Teacher attrition and retention in Kansas: A case study of geographically rural states with persistent teacher shortages. *Online Journal of Rural Research & Policy*, *15*(1). https://doi.org/10.4148/1936-0487.1100

Nguyen, T. D. (2021). Linking school organizational characteristics and teacher retention: Evidence from repeated cross-sectional national data. *Teaching and Teacher Education*, *97*, 103220. https://doi.org/10.1016/j.tate.2020.103220

Nguyen, T. D., Anglum, J. C., & Crouch, M. (2023). The effects of school finance reforms on teacher salary and turnover: Evidence from national data. *AERA Open*, *9*, 233285842311744. https://doi.org/10.1177/23328584231174447

Nguyen, T. D., Lam, C. B., & Bruno, P. (2022). Is there a national teacher shortage? A systematic examination of reports of teacher shortages in the United States. *EdWorkingPaper: 22-631*. https://doi.org/10.26300/76EQ-HJ32

Nguyen, T. D., Lam, C. B., & Bruno, P. (2024). What do we know about the extent of teacher shortages nationwide? A systematic examination of reports of U.S. teacher shortages. *AERA Open*, *10*, 23328584241276512. https://doi.org/10.1177/23328584241276512

Nguyen, T. D., Pham, L. D., Crouch, M., & Springer, M. G. (2020). The correlates of teacher turnover: An updated and expanded Meta-analysis of the literature. *Educational Research Review*, *31*, 100355. https://doi.org/10.1016/j.edurev.2020.100355

Nguyen, T. D., & Springer, M. G. (2023). A conceptual framework of teacher turnover: A systematic review of the empirical international literature and insights from the employee turnover literature. *Educational Review*, *75*(5), 993–1028. https://doi.org/10.1080/00131911.2021.1940103

Northup, K. M. (2018). *Teacher intra-district migration out of Title 1 schools: Case study of Midwestern suburban school district* [Doctoral dissertation]. University of Kansas.

Odell, S. J., & Ferraro, D. P. (1992). Teacher mentoring and teacher retention. *Journal of Teacher Education*, *43*(3), 200–204. https://doi.org/10.1177/0022487192043003006

Pham, L. D., Nguyen, T. D., & Springer, M. G. (2021). Teacher merit pay: A meta-analysis. *American Educational Research Journal*, *58*(3), 527–566. https://doi.org/10.3102/0002831220905580

Postal, L. (2023, January 13). Florida teacher vacancies soar to nearly 5,300 in January. *Orlando Sentinel*. https://www.orlandosentinel.com/2023/01/13/florida-teacher-vacancies-soar-to-nearly-5300-in-january/

Redding, C. (2019). A teacher like me: A review of the effect of student–teacher racial/ethnic matching on teacher perceptions of students and student academic and behavioral outcomes. *Review of Educational Research*, *89*(4), 499–535. https://doi.org/10.3102/0034654319853545

Rhinesmith, E., Anglum, J. C., Park, A., & Burrola, A. (2023). Recruiting and retaining teachers in rural schools: A systematic review of the literature. *Peabody Journal of Education*, *98*(4), 347–363. https://doi.org/10.1080/0161956X.2023.2238491

Rodriguez, L. A., Swain, W. A., & Springer, M. G. (2020). Sorting through performance evaluations: The influence of performance evaluation reform on teacher attrition and mobility. *American Educational Research Journal*, *57*(6), 2339–2377. https://doi.org/10.3102/0002831220910989

Ronfeldt, M., Loeb, S., & Wyckoff, J. (2013). How teacher turnover harms student achievement. *American Educational Research Journal*, *50*(1), 4–36. https://doi.org/10.3102/0002831212463813

Ronfeldt, M., & McQueen, K. (2017). Does new teacher induction really improve retention? *Journal of Teacher Education*, *68*(4), 394–410. https://doi.org/10.1177/0022487117702583

Rutz, J. (2022, September 7). Delaware schools need 500 teachers. Here's where. *Delaware Live*. https://delawarelive.com/delaware-schools-need-500-teachers-heres-where/

Scannell, D. P. (1984). The extended teacher education program at the University of Kansas. *The Phi Delta Kappan*, *66*(2), 130–133.

Scott, L., Kearney, W. S., Krimbill, E., & Hinojosa, N. (2023). Teacher-student race congruence: Does it matter, and what can principals do about it? *The Urban Review*, *55*(3), 315–336. https://doi.org/10.1007/s11256-022-00650-5

Senate Bill No. 727, 727, 3329S.24T (2024). https://www.senate.mo.gov/24info/pdf-bill/intro/SB727.pdf

Simon, N., & Johnson, S. M. (2015). Teacher turnover in high-poverty schools: What we know and can do. *Teachers College Record: The Voice of Scholarship in Education*, *117*(3), 1–36. https://doi.org/10.1177/016146811511700305

Skillett, J. D. (1981). *Teacher supply and demand in Kansas public schools: Second annual survey*. Emporia State University.

Sorensen, L. C., & Ladd, H. F. (2020). The hidden costs of teacher turnover. *AERA Open*, *6*(1), 233285842090581. https://doi.org/10.1177/2332858420905812

Stewart, K. (2016). *Kansas special education attrition report 2014-2015*. Greenbush - The Education Service Center.

Stewart, K. (2018). *Kansas math educators attrition study 2018*. Greenbush - The Education Service Center.

Strunk, K. O., & Zeehandelaar, D. (2011). Differentiated compensation: How California school districts use economic incentives to target teachers. *Journal of Education Finance*, *36*(3), 268–293.

Sutcher, L., Darling-Hammond, L., & Carver-Thomas, D. (2016). *A coming crisis in teaching? Teacher supply, demand, and shortages in the U.S.* Learning Policy Institute. https://learningpolicyinstitute.org/product/coming-crisis-teaching

Sutcher, L., Darling-Hammond, L., & Carver-Thomas, D. (2019). Understanding teacher shortages: An analysis of teacher supply and demand in the United States. *Education Policy Analysis Archives*, *27*, 35. https://doi.org/10.14507/epaa.27.3696

Swaak, T. (2019, January 22). A look into the LAUSD, UTLA contract deal ending the 6-day teacher strike. *LA School Report*. https://www.laschoolreport.com/a-look-into-the-lausd-utla-contract-deal-that-could-end-the-6-day-teacher-strike/

Taie, S., & Lewis, L. (2023). *Teacher attrition and mobility: Results from the 2021–22 teacher follow-up survey to the national teacher and principal survey* (No. NCES 2024-039). National Center for Education Statistics. https://nces.ed.gov/pubs2024/2024039M.pdf

Tan, T. S., Arellano, I., & Patrick, S. K. (2024). *State teacher shortages 2024 update: Teaching positions left vacant or filled by teachers without full certification*. Learning Policy Institute. https://learningpolicyinstitute.org/media/4412/download?inline&file=State_Vacancy_2024_RESOURCE.pdf

Teacher shortages in the United States. (n.d.). https://teachershortages.com/

The Kansas Board of Regents. (n.d.). *Scholarships and Grants*. https://www.kansasregents.org/scholarships_and_grants

The Kansas Board of Regents. (2024). *Kansas teacher service scholarship*. https://www.kansasregents.org/resources/PDF/Students/Student_Financial_Aid/KTS_24-25.pdf

Tompkins, L., Mehring, T. A., Hedstrom, C. Z., & Switzer, M. (1999). *Teacher supply and demand in Kansas public schools: Twentieth annual survey*. Jones Institute for Educational Excellence, Emporia State University.

U.S. Bureau of Labor Statistics. (2024, August 29). *Employment in STEM occupations*. Bureau of Labor Statistics. https://www.bls.gov/emp/tables/stem-employment.htm

VanCise, S. A. (2013). *A descriptive study of the impact of the highly qualified teacher requirement of NCLB on the attrition of special education personnel* [Doctoral dissertation, University of Kansas]. KU ScholarWorks.

Viano, S., Rodriguez, L. A., & Hunter, S. B. (2023). Principal and Teacher Shared Race and Gender Intersections: Teacher Turnover, Workplace Conditions, and Monetary Benefits. *AERA Open*, *9*, 23328584221148156. https://doi.org/10.1177/23328584221148156

Whitney, S. (2023, January 11). Teacher shortage worsens in South Dakota due to politics, low pay and lack of respect. *South Dakota News Watch*. https://www.sdnewswatch.org/stories/teacher-shortage-worsens-in-south-dakota-due-to-politics-low-pay-and-lack-of-respect/

Wright, E. L., & Nassar, I. (1991, April 8). *An assessment of factors related to the attrition and retention of science and mathematics teachers in Kansas*. Annual Meeting of the National Association for Research in Science Teaching, Lake Geneva, WI, April 7-10, 1991.

Zabel, R. H., & Zabel, M. K. (2002). Burnout among special education teachers and perceptions of support. *Journal of Special Education Leadership*, *15*(2), 67–73.

Appendix A - Data and Sample details

Appendix Table A1. Variable description

Mobility Measures in Descriptive Analysis	
Stayer	= 1 if the teacher stays in the same school from one school year through the immediately next school year; = 0 if switches to another school within the same district, switches to another district within the same state, or completely leaves the state's public schools while their current school remains open.
Closure Mover	= 1 if the teacher's current school closes; = 0 if the school remains open through the next school year.
Turnover	= 1 if the teacher switches to another school within the same district, switches to another district within the same state, or completely leaves the state's public schools while their current school remains open; = 0 if Stayer = 1 or Closure Mover = 1 (i.e., Stayer + Closure Mover + Turnover = 1).
School Switcher	= 1 if the teacher switches to another school within the same district while their current school remains open through the next school year; = 0 if Stayer = 1 or Closure Mover = 1.
District Switcher	= 1 if the teacher switches to another school district within the same state while their current school remains open through the next school year; = 0 if Stayer = 1 or Closure Mover = 1.
Leaver	= 1 if the teacher leaves the state's public schools while their current school remains open through the next school year; = 0 if Stayer = 1 or Closure Mover = 1 (i.e., School Switcher + District Switcher + Leaver = Turnover).
Short-term Leaver	= 1 if the teacher leaves the state's public schools while their current school remains open through the next school year, and returns to one of the state's public schools within three school years; = 0 if not returns to the state's public schools for more than three school years, or Stayer = 1 or Closure Mover = 1.
Long-term Leaver	= 1 if the teacher leaves the state's public schools while their current school remains open through the next school year, and does not return to the state's public schools for more than three school years; = 0 if Short-term Leaver = 1, or Stayer = 1 or Closure Mover = 1.
Mobility Measures in Regression Analysis (i.e., dependent variables)	
Turnover (DV)	= 1 if the teacher switches to another school within the same district of the current school, switches to another district within the same state, or completely leaves the state's public schools while their current school remains open; = 0 if Stayer = 1.
School Switcher (DV)	= 1 if the teacher switches to another school within the same district while their current school remains open through the next school year; = 0 if Stayer = 1.
District Switcher (DV)	= 1 if the teacher switches to another school district within the same state while their current school remains open through the next school year; = 0 if Stayer = 1.
Leaver (DV)	= 1 if the teacher leaves the state's public schools while their current school remains open through the next school year; = 0 if Stayer = 1.
Independent variables and covariates	
Female	= 1 if recorded as female in the state's data system; = 0 if recorded as male.

Under 30	= 1 if the teacher's age (in years) is less than 30; = 0 if age is 30 or higher.
Above 65	= 1 if the teacher's age (in years) is greater than 65; = 0 if age is 65 or lower.
White	= 1 if recorded as White; = 0 if recorded as if recorded as Asian, Black, Hispanic, Multi-racial, Native American, or Pacific Islanders in the state's data system.
Teachers of color	= 1 if recorded as Asian, Black, Hispanic, Multi-racial, Native American, or Pacific Islanders; = 0 if recorded as White in the state's data system.
Asian	= 1 if recorded as Asian; = 0 if recorded as Black, Hispanic, Multi-racial, Native American, Pacific Islanders, or White in the state's data system.
Black	= 1 if recorded as Black; = 0 if recorded as Asian, Hispanic, Multi-racial, Native American, Pacific Islanders, or White in the state's data system.
Hispanic	= 1 if recorded as Hispanic; = 0 if recorded as Asian, Black, Multi-racial, Native American, Pacific Islanders, or White in the state's data system.
Multi/Native/Pacific	= 1 if recorded as Multi-racial, Native American, or Pacific Islanders; = 0 if recorded as Asian, Black, Hispanic, or White in the state's data system.
Novice	= 1 if having less than or equal to three years of total teaching experience; = 0 if having four or more years of total teaching experience.
STEM Certified	= 1 if being certified in a STEM area; = 0 if not certified in any STEM area. • The STEM certification area is identified using the following search and counter search strings: o Search = math arithmetic algebra geometry trigonometry calculus statistics probability coding programming "computer science" "computer and information science" science physics chemistry biology botany zoology "computer studies" o Counter-search = family consumer health military social behavioral political library fiction "technical science"
CTE Certified	= 1 if being certified in a CTE area; = 0 if not certified in any CTE area. • The CTE certification area is identified using the following search and counter search strings: o Search = occupation vocation career 61nglish61ty61 horticultur business market 61nglish transport logistic distribution "health care" healthcare construct trad engine tech mechanic repair manufact produc electron electric metal cloth textile design graphics printing culinary cosmetology "child care" "social work" protective custodial interior family consumer food hospitality 61nglish61 energy power auto machine process shop mill weld draft carpentry material plastic metal wood "air conditioning & refrig" "voc st" "office practice" "comb coop program" / o Counter-search = "bilingual/multicultural educ" "elem/sec principal" "law enf/police sci" "nursing asst/aide" "oper 61ngli/supervisn" "political science/government" "special education supv/coord" "supv speech/language path" speech/theatre tech/asst occupational/coordinator "speech/language pathologist" "surg/oper room tech" technican "mild/mod behv disord" "mild/mod cross categorical" "mild/mod learn disab" "mild/mod mental hand" "mild/mod phys impair"

SPED/ESOL Certified	= 1 if being certified in a SPED or ESOL area; = 0 if not certified in any SPED nor ESOL area. • The SPED certification area is identified using the following search and counter search strings: o Search = adapt behavior deaf hear special retard functional 62nglish62ty incidence impair handicap "homebound & hospitalized" "sped/esol type" gifted o Counter-search = automotive "reading specialist" "vocational special needs" "school specialist" • The ESOL certification area is identified using the following search and counter search strings: o Search = bilingual second other "ellesol/esol type" o Counter-search = auto foreign counselor
Grad Degree	= 1 if obtained a graduate degree at or above the master's level; = 0 if did not obtained a graduate degree at or above the master's level.
Elementary	= 1 if taught in an elementary school (defined below) and not having a SPED/ESOL assignment; = 0 if otherwise.
STEM	= 1 if taught in a STEM area in a non-elementary school (defined below) and not having a SPED/ESOL assignment; = 0 if otherwise. • The STEM subject area is identified using one set of search and counter-search strings on course category titles, and another set of search and counter-search strings on course subject titles. Course category search: o Search = math science o Counter-search = family consumer health military social "technical science" information cluster Course subject search: o Search = math arithmetic algebra geometry trigonometry calculus statistics probability coding programming "computer science" "computer and information science" physics chemistry biology botany zoology o Counter-search = administrator counslr counselor coordinator director librarian technician therapist evaluator "social worker" specialist supervis
CTE (non-STEM)	= 1 if taught in a CTE area in a non-elementary school (defined below) and not having a STEM or SPED/ESOL assignment; = 0 if otherwise. • The CTE subject area is identified using one set of search and counter-search strings on course category titles, and another set of search and counter-search strings on course subject titles. Course category search: o Search = occupation vocation career agricultur horticultur business market logistic distribution "health care" healthcare construct trad engine tech mechanic repair manufact produc electron electric metal cloth textile design graphics printing culinary cosmetology "child care" "social work" protective custodial interior family consumer food industr energy power o Counter-search = Did not apply Course subject search: o Search = occupation vocation career agricultur horticultur business market logistic distribution "health care" healthcare construct trad engine tech mechanic repair manufact produc electron electric metal cloth textile

	design graphics printing culinary cosmetology "child care" "social work" protective custodial interior family consumer food industr energy power o Counter-search = "vocational special needs guidance" "career education teacher aide" "career explorations" "career education/planning" "career education and planning" "business law" "secretarial science" technologist technician "tech support" "dance technique" music administrator counslr counselor coordinator director librarian technician therapist evaluator "social worker" specialist supervis
Other non-ELE	= 1 if taught in a non-elementary school (defined below) and not having a SPED/ESOL, STEM, or CTE assignment; = 0 if otherwise.
SPED/ESOL	= 1 if taught in a SPED or ESOL area or had a self-contained classroom teaching assignment classified as SPED/ESOL by the state's original data (regardless of the school level); = 0 if otherwise. • The SPED subject area is identified using one set of search and counter-search strings on course category titles, and another set of search and counter-search strings on course subject titles. Course category search: o Search = adapt behavior deaf hear special retard functional disabilit incidence impair handicap "homebound & hospitalized" "sped/esol type" gifted o Counter-search = automotive "reading specialist" "vocational special needs" "school specialist" Course subject search: o Search = adapt behavior deaf hear special retard functional disabilit incidence impair handicap "homebound & hospitalized" "sped/esol type" gifted o Counter-search = administrator counslr counselor coordinator director librarian technician therapist evaluator "social worker" specialist supervis specialization specialty • The ESOL subject area is identified using one set of search and counter-search strings on course category titles, and another set of search and counter-search strings on course subject titles. Course category search: o Search = bilingual "english to speakers of other languages" "english language learner" "sped/esol type" o Counter-search = Did not apply Course subject search: o Search = "english as a second language" o Counter-search = administrator counslr counselor coordinator director librarian technician therapist evaluator "social worker" specialist supervis
Elementary school	= 1 if the school's lowest grade offered (GSLO) is pre-kindergarten (PK), kindergarten (KG), 01, 02, 03, or 04; and, the school's highest grade offered (GSHI) is PK, KG, 01, 02, 03, 04, 05, 06, 07, or 08; = 0 if otherwise.
Middle school	= 1 if GSLO = 05, 06, 07, or 08, and GSHI = 05, 06, 07, or 08; = 0 if otherwise
High school	= 1 if GSLO = 07, 08, 09, 10, 11, 12, or 13, and GSHI = 12, or 13; = 0 if otherwise
Other level	= 1 if GSLO = Ungraded and GSHI = Ungraded, or GSLO = Adult Education and GSHI = Adult Education, or all other combinations that are not classified into the elementary, middle, and high school categories; = 0 if otherwise.

Full-time or Equivalent	= FTE recorded at the school level
FTE Flag (abnormal data flag)	= 0 if FTE is greater than 0.0 and less than or equal to 1.0; = 1 if FTE equals 0.0; = 2 if FTE is greater than 1.0.
Base Salary	= Base contract salary, not including supplemental contracts or fringe benefits.
Inf-adj Base Salary	= Inflation adjusted Base Salary in 2023-2024 dollars (July 2023 through June 2024).
Base Salary Flag (abnormal data flag)	= 1 if Base Salary is less than or equal to the first annual percentile or greater than or equal to the 99th annual percentile among all Base Salary figures of the state in the respective school year; = 0 if otherwise.
Total Salary	= Base contact salary plus supplemental and fringe. Total salary including all supplemental contracts and board paid fringe benefits.
Inf-adj Total Salary	= Inflation adjusted Total Salary in 2023-2024 dollars (July 2023 through June 2024).
Total Salary Flag (abnormal data flag)	= 1 if Total Salary is less than or equal to the first annual percentile or greater than or equal to the 99th annual percentile among all Total Salary figures of the state in the respective school year; = 0 if otherwise.
City School	= 1 if CCD's School-level Locale Code is 11, 12, 13; = 0 if otherwise. • 11 = City, Large: Territory inside an urbanized area and inside a principal city with population of 250,000 or more. • 12 = City, Midsize: Territory inside an urbanized area and inside a principal city with population less than 250,000 and greater than or equal to 100,000. • 13 = City, Small: Territory inside an urbanized area and inside a principal city with population less than 100,000.
Suburban School	= 1 if CCD's School-level Locale Code is 21, 22, 23; = 0 if otherwise. • 21 = Suburban, Large: Territory outside a principal city and inside an urbanized area with population of 250,000 or more. • 22 = Suburban, Midsize: Territory outside a principal city and inside an urbanized area with population less than 250,000 and greater than or equal to 100,000. • 23 = Suburban, Small: Territory outside a principal city and inside an urbanized area with population less than 100,000.
Rural/Town School	= 1 if CCD's School-level Locale Code is 31, 32, 33, 41, 42, 43; = 0 if otherwise. • 31 = Town, Fringe: Territory inside an urban cluster that is less than or equal to 10 miles from an urbanized area. • 32 = Town, Distant: Territory inside an urban cluster that is more than 10 miles and less than or equal to 35 miles from an urbanized area. • 33 = Town, Remote: Territory inside an urban cluster that is more than 35 miles from an urbanized area. • 41 = Rural, Fringe: Census-defined rural territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster.

	• 42 = Rural, Distant: Census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban cluster. • 43 = Rural, Remote: Census-defined rural territory that is more than 25 miles from an urbanized area and is also more than 10 miles from an urban cluster.
Student Enrollment/10K	= School-level sum of students per 10,000 students
Percent Female	= Sum of students recorded as female over the school's sum of students in 100 percent
Percent Students of color	= Sum of students recorded as Native American, Asian, African American, Hispanic, Pacific Islanders, and Multi-racial over the school's sum of students in 100 percent
Percent FRPL Eligible	= Sum of students eligible for free- or reduced-price lunch over the school's sum of students in 100 percent
Relative Urbanicity (percentile)	= Percentile of the teacher's school district among Kansas school districts per latest the recombined measure from CARR data (Nelson & Nguyen, 2023), including availability and accessibility of community assets, population density, and percent developed land. The recombined measure is computed by: CARR (recombined) = Avail – 1/3*(Access1 + Access2 +Access3) + 1/2*(PopDensity + LandPercDeveloped).
Community asset availability (Avail)	= Weighted average of the original availability factor score in Nelson and Nguyen's (2023) CARR data. Weighting factors were calculated as the ratio of the area of intersection of the original CARR block group and the new geographic unit of interest and the total area of the new geographic unit.
Community asset accessibility scores (Access1, Access2, and Access3)	= Weighted averages of the original first, second, and third accessibility factor scores in Nelson and Nguyen's (2023) CARR data. Larger values of the first accessibility factor are associated with greater distances to amenities. Larger values of the second accessibility factor are associated with increased distance to essential services. Larger values of the third accessibility factor are associated with greater distances to both amenities and natural resource extraction (e.g. peri-urban). Weighting factors were calculated as the ratio of the area of intersection of the original CARR block group and the new geographic unit of interest and the total area of the new geographic unit.
Population density (PopDensity)	= Weighted average of the original population density value (Nelson & Nguyen, 2023). Weighting factors were calculated as the ratio of the area of intersection of the original CARR block group and the new geographic unit of interest and the total area of the new geographic unit.
Percent developed land (LandPercDeveloped)	= Weighted average of the original percent developed land cover value (Nelson & Nguyen, 2023). Weighting factors were calculated as the ratio of the area of intersection of the original CARR block group and the new geographic unit of interest and the total area of the new geographic unit.

Appendix Table A2. Out of sample rates

	Unduplicated teacher observations of interest	Out-of-sample rates	Out-of-sample standard deviation
2010-2011	32552	0.040	0.197
2011-2012	32152	0.014	0.117
2012-2013	33351	0.011	0.104
2013-2014	33955	0.007	0.082
2014-2015	33996	0.009	0.093
2015-2016	33974	0.008	0.089
2016-2017	33628	0.012	0.110
2017-2018	32737	0.015	0.123
2018-2019	32490	0.011	0.106
2019-2020	32287	0.011	0.103
2020-2021	33407	0.012	0.107
2021-2022	33344	0.018	0.132
2022-2023	33390	0.014	0.118
2023-2024	32692	0.018	0.134

Note: Observations of interest include teachers who served Kansas public elementary and secondary schools from 2010-2011 through 2023-2024, excluding central offices, off-site/community-based schools, and specialized educational services and/or programs such as Early Childhood Head Start, summer schools, learning centers, and special education service centers due to the inconsistent reporting of these units over time. The out-of-sample rate captures the share of unduplicated teacher observations that do not provide a complete set of data due to missing by one or more data points.

Appendix B - School indicators

Appendix Table B1. Students of color and FRPL eligibility school-level benchmarks

	25th percent students of color	Median percent students of color	75th percent students of color	25th percent FRPL eligibility	Median percent FRPL eligibility	75th percent FRPL eligibility
2010-2011	9.11	17.16	36.56	34.49	49.60	64.15
2011-2012	9.09	17.15	37.14	35.29	50.46	65.74
2012-2013	9.30	17.24	37.33	35.91	50.62	65.54
2013-2014	9.80	17.53	38.46	37.46	51.66	66.10
2014-2015	10.20	18.79	39.68	36.27	51.34	66.00
2015-2016	10.24	19.18	39.85	35.82	51.03	65.45
2016-2017	10.61	19.13	40.36	35.51	49.84	65.05
2017-2018	10.53	19.44	39.93	33.66	49.53	64.66
2018-2019	11.16	19.51	41.13	33.83	48.15	63.64
2019-2020	11.37	21.04	41.38	32.74	47.95	62.75
2020-2021	11.71	21.41	42.35	31.76	46.22	62.00
2021-2022	11.94	21.82	43.37	30.17	44.85	59.81
2022-2023	12.41	22.48	43.88	34.73	49.90	64.93
2023-2024	12.88	23.30	45.30	35.88	50.86	66.15

Appendix C - Descriptive statistics and regression results

Appendix Table C1. Full sample descriptive statistics

	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	Pooled
Stayer	0.858	0.864	0.847	0.850	0.843	0.837	0.822	0.829	0.833	0.833	0.851	0.822	0.803	.	0.838
Closure Mover	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	.	0.000
Turnover	0.142	0.136	0.153	0.150	0.157	0.163	0.178	0.171	0.167	0.167	0.149	0.178	0.196	.	0.162
School Switcher	0.038	0.032	0.033	0.025	0.026	0.027	0.025	0.028	0.028	0.026	0.024	0.034	0.030	.	0.029
District Switcher	0.015	0.019	0.029	0.029	0.034	0.036	0.035	0.038	0.038	0.034	0.027	0.035	0.037	.	0.031
Leaver	0.090	0.085	0.091	0.095	0.098	0.100	0.119	0.104	0.101	0.107	0.098	0.109	0.129	.	0.102
Short-term Leaver	0.016	0.013	0.014	0.015	0.015	0.013	0.018	0.015	0.015	0.019	0.019	.	.	.	0.016
Long-term Leaver	0.074	0.072	0.077	0.080	0.083	0.087	0.101	0.090	0.087	0.088	0.080	.	.	.	0.084
Female	0.765	0.767	0.762	0.761	0.760	0.759	0.761	0.761	0.762	0.764	0.759	0.761	0.763	0.762	0.762
Under 30	.	.	0.116	0.128	0.139	0.147	0.154	0.160	0.165	0.168	0.164	0.165	0.167	.	0.152
Above 65	.	.	0.069	0.061	0.051	0.042	0.032	0.026	0.024	0.022	0.023	0.017	0.014	.	0.035
White	0.949	0.948	0.948	0.947	0.945	0.943	0.942	0.940	0.935	0.934	0.928	0.927	0.925	0.919	0.938
Teacher of Color	0.051	0.052	0.052	0.053	0.055	0.057	0.058	0.060	0.065	0.066	0.072	0.073	0.075	0.081	0.062
Asian	0.006	0.006	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.007	0.007	0.008	0.009	0.006
Black	0.015	0.014	0.014	0.015	0.015	0.016	0.016	0.015	0.016	0.016	0.018	0.018	0.018	0.020	0.016
Hispanic	0.020	0.021	0.022	0.023	0.024	0.025	0.026	0.028	0.031	0.032	0.035	0.036	0.038	0.041	0.029
Multi/Native/Pacific	0.011	0.011	0.010	0.010	0.011	0.011	0.011	0.011	0.012	0.012	0.013	0.012	0.012	0.012	0.011
Novice	0.182	0.165	0.162	0.176	0.189	0.197	0.195	0.187	0.187	0.184	0.195	0.192	0.195	0.199	0.186
STEM Certified	0.166	0.162	0.163	0.163	0.160	0.158	0.155	0.154	0.153	0.151	0.150	0.146	0.142	0.137	0.154
CTE Certified	0.049	0.048	0.056	0.055	0.055	0.055	0.053	0.051	0.050	0.047	0.049	0.046	0.046	0.046	0.050
SPED/ESOL Certified	0.232	0.234	0.232	0.230	0.231	0.228	0.228	0.214	0.208	0.204	0.196	0.191	0.189	0.182	0.214
Grad Degree	0.379	0.380	0.388	0.384	0.376	0.369	0.361	0.343	0.334	0.320	0.338	0.329	0.320	0.331	0.354
Elementary	0.439	0.436	0.425	0.423	0.428	0.429	0.434	0.438	0.439	0.439	0.433	0.434	0.432	0.436	0.433
STEM	0.135	0.137	0.155	0.161	0.162	0.160	0.160	0.157	0.152	0.155	0.155	0.155	0.154	0.149	0.153
CTE (non-STEM)	0.033	0.032	0.036	0.038	0.041	0.039	0.039	0.039	0.038	0.037	0.044	0.042	0.041	0.042	0.039
Other non-ELE	0.276	0.275	0.281	0.280	0.283	0.288	0.287	0.286	0.287	0.289	0.283	0.279	0.285	0.282	0.283
SPED/ESOL	0.117	0.120	0.104	0.098	0.087	0.084	0.079	0.080	0.083	0.081	0.085	0.089	0.088	0.092	0.092
Multiple schools in one dist.	0.054	0.058	0.067	0.068	0.064	0.063	0.057	0.057	0.055	0.053	0.053	0.058	0.052	0.050	0.058
Multiple districts	0.003	0.004	0.005	0.007	0.006	0.010	0.011	0.003	0.002	0.002	0.002	0.001	0.001	0.001	0.004
Full-time or Equivalent	0.945	0.950	0.950	0.957	0.950	0.949	0.956	0.953	0.953	0.962	0.963	0.958	0.965	0.965	0.955
FTE Flag	0.005	0.000	0.004	0.010	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
City School	0.234	0.226	0.248	0.249	0.252	0.262	0.263	0.269	0.272	0.273	0.276	0.271	0.272	0.287	0.261

Suburban School	0.132	0.132	0.160	0.161	0.158	0.153	0.154	0.157	0.160	0.157	0.159	0.161	0.167	0.186	0.157
Rural/Town School	0.634	0.642	0.592	0.590	0.590	0.585	0.584	0.574	0.568	0.570	0.565	0.568	0.561	0.527	0.582
Student Enrollment per 10K	56.554	56.780	56.792	57.432	58.114	58.671	59.033	59.584	59.820	60.226	59.458	59.145	59.803	59.501	58.638
Percent Female	48.531	48.468	48.418	48.440	48.491	48.489	48.406	48.459	48.569	48.515	48.499	48.511	48.508	48.469	48.483
Percent Students of color	30.978	31.592	31.767	32.427	33.033	33.659	34.132	34.884	35.681	35.871	36.408	36.583	37.167	37.853	34.431
Percent FRPL Eligible	48.478	49.851	50.289	51.068	50.708	50.230	49.650	49.197	48.632	48.142	47.148	45.090	49.685	50.728	49.217
Total Salary per $10K	5.049	5.067	5.104	5.160	5.187	5.283	5.337	5.413	5.579	5.734	5.958	6.071	6.195	6.358	5.535
Inf-adj Total Salary per $10K	7.070	6.893	6.829	6.798	6.785	6.864	6.809	6.753	6.819	6.901	7.009	6.664	6.399	6.358	6.782
Base Salary per $10K	4.465	4.468	4.486	4.548	4.581	4.652	4.672	4.726	4.897	5.021	5.171	5.265	5.379	5.512	4.845
Inf-adj Base Salary per $10K	6.252	6.078	6.003	5.992	5.992	6.044	5.961	5.896	5.986	6.042	6.083	5.779	5.557	5.512	5.941
Total Salary flag	0.024	0.021	0.022	0.022	0.020	0.023	0.020	0.021	0.024	0.021	0.024	0.019	0.024	0.029	0.022
Base Salary Flag	0.030	0.025	0.025	0.028	0.026	0.028	0.027	0.028	0.029	0.027	0.024	0.022	0.024	0.030	0.027
Rel. Urbanicity (percentile)	79.624	79.204	79.001	79.040	79.161	79.416	79.704	80.213	80.573	80.800	81.029	80.949	81.245	81.519	80.099
Observations	31235	31704	32989	33726	33701	33701	33217	32232	32120	31944	33018	32753	32916	32090	457346

Appendix Table C2. Subsample descriptive statistics

	Elementary	STEM	CTE	Other non-ELE	SPED/ ESOL	City	Suburban	Rural/ Town	Low-minoritized	High-minoritized	Low-impoverished	High-impoverished
Stayer	0.844	0.845	0.829	0.841	0.788	0.823	0.856	0.840	0.852	0.829	0.852	0.823
Closure Mover	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Turnover	0.156	0.155	0.171	0.159	0.212	0.177	0.144	0.160	0.148	0.171	0.148	0.177
School Switcher	0.034	0.020	0.015	0.021	0.050	0.042	0.036	0.021	0.017	0.036	0.023	0.034
District Switcher	0.028	0.035	0.029	0.032	0.039	0.024	0.019	0.038	0.036	0.029	0.028	0.035
Leaver	0.093	0.100	0.127	0.106	0.123	0.111	0.089	0.102	0.095	0.106	0.097	0.107
Leaver back w/in 3Y	0.013	0.014	0.035	0.017	0.016	0.017	0.013	0.015	0.015	0.016	0.015	0.016
Leaver over 3Y	0.078	0.082	0.092	0.085	0.106	0.089	0.072	0.084	0.078	0.087	0.079	0.088
Female	0.900	0.619	0.574	0.613	0.885	0.784	0.795	0.743	0.739	0.775	0.740	0.785
Under 30	0.185	0.141	0.102	0.127	0.110	0.164	0.137	0.151	0.136	0.161	0.136	0.168
Above 65	0.026	0.036	0.046	0.042	0.047	0.034	0.032	0.036	0.037	0.034	0.036	0.034
White	0.939	0.942	0.962	0.935	0.922	0.882	0.954	0.958	0.975	0.916	0.964	0.910
Teacher of Color	0.061	0.058	0.038	0.065	0.078	0.118	0.046	0.042	0.025	0.084	0.036	0.090
Asian	0.004	0.013	0.002	0.004	0.014	0.014	0.005	0.003	0.002	0.009	0.004	0.008
Black	0.016	0.014	0.010	0.018	0.017	0.044	0.009	0.006	0.002	0.024	0.006	0.027
Hispanic	0.029	0.020	0.017	0.032	0.037	0.045	0.021	0.023	0.012	0.038	0.016	0.041
Multi/Native/Pacific	0.012	0.010	0.008	0.011	0.010	0.015	0.012	0.009	0.008	0.013	0.009	0.013
Novice	0.211	0.171	0.145	0.163	0.184	0.220	0.154	0.180	0.156	0.204	0.156	0.218
STEM Certified	0.043	0.684	0.143	0.074	0.045	0.133	0.134	0.169	0.176	0.142	0.178	0.130
CTE Certified	0.004	0.033	0.529	0.075	0.018	0.028	0.036	0.064	0.070	0.039	0.062	0.039
SPED/ESOL Certified	0.161	0.147	0.083	0.146	0.844	0.230	0.208	0.209	0.166	0.243	0.188	0.242
Grad Degree	0.264	0.377	0.387	0.391	0.612	0.369	0.398	0.335	0.336	0.364	0.370	0.338
Elementary	1.000	0.000	0.000	0.000	0.000	0.443	0.456	0.423	0.441	0.428	0.379	0.488
STEM	0.000	1.000	0.000	0.000	0.000	0.143	0.138	0.162	0.160	0.150	0.169	0.137
CTE (non-STEM)	0.000	0.000	1.000	0.000	0.000	0.021	0.027	0.050	0.052	0.031	0.046	0.031
Other non-ELE	0.000	0.000	0.000	1.000	0.000	0.276	0.291	0.284	0.281	0.284	0.325	0.240
SPED/ESOL	0.000	0.000	0.000	0.000	1.000	0.118	0.088	0.081	0.066	0.107	0.080	0.104
Multiple schools in one dist.	0.046	0.034	0.074	0.085	0.065	0.026	0.033	0.079	0.091	0.038	0.066	0.049
Multiple districts	0.001	0.004	0.006	0.005	0.014	0.001	0.001	0.006	0.008	0.002	0.005	0.003
Full-time or Equivalent	0.962	0.974	0.931	0.942	0.944	0.965	0.968	0.948	0.940	0.965	0.950	0.961
FTE Flag	0.002	0.002	0.002	0.002	0.003	0.001	0.004	0.002	0.002	0.002	0.002	0.002

City School	0.267	0.243	0.141	0.254	0.336	1.000	0.000	0.000	0.018	0.405	0.164	0.361
Suburban School	0.165	0.141	0.110	0.162	0.150	0.000	1.000	0.000	0.116	0.181	0.238	0.074
Rural/Town School	0.568	0.616	0.749	0.584	0.515	0.000	0.000	1.000	0.866	0.414	0.598	0.565
Student Enrollment per 10K	38.519	75.201	61.249	80.967	55.951	74.787	78.653	45.994	36.879	71.489	62.389	54.771
Percent Female	48.339	48.627	48.586	48.644	48.388	48.534	48.726	48.395	48.386	48.541	48.476	48.491
Percent Students of color	35.055	33.088	26.931	33.295	40.387	57.766	29.296	25.349	11.748	47.827	20.729	48.556
Percent FRPL Eligible	52.321	46.699	44.000	45.265	53.159	61.693	33.076	47.977	38.675	55.443	29.686	69.351
Total Salary per $10K	5.313	5.651	5.700	5.796	5.509	5.884	6.018	5.247	5.238	5.710	5.583	5.484
Inf-adj Total Salary per $10K	6.512	6.918	6.945	7.100	6.778	7.181	7.330	6.455	6.432	6.988	6.842	6.719
Base Salary per $10K	4.720	4.901	4.891	4.988	4.885	5.089	5.355	4.599	4.599	4.991	4.918	4.770
Inf-adj Base Salary per $10K	5.789	6.002	5.963	6.113	6.015	6.211	6.531	5.660	5.651	6.112	6.031	5.847
Total Salary flag	0.010	0.021	0.038	0.045	0.009	0.025	0.042	0.016	0.018	0.025	0.030	0.014
Base Salary Flag	0.019	0.022	0.032	0.045	0.013	0.034	0.056	0.016	0.021	0.030	0.036	0.017
Rel. Urbanicity (percentile)	80.061	78.616	68.297	81.187	84.369	98.176	96.428	67.585	64.966	89.037	79.730	80.480
Observations	198073	70194	17666	129395	42018	119385	71809	266152	169816	287530	232149	225197

Appendix Table C3. Regression model selection

	Ttype only	Added **TScov** (teacher set)	Added **Work**	Added **TScov** (school set)	Added adjusted salary & flag	Added percentile relative urbanicity	Added year fixed effect	Added county fixed effect
STEM	-0.0005	0.0110**	0.0119**	0.0193**	0.0201**	0.0210**	0.0196**	0.0203**
	(0.0030)	(0.0031)	(0.0031)	(0.0032)	(0.0032)	(0.0031)	(0.0031)	(0.0030)
CTE (non-STEM)	0.0156**	0.0003	0.0026	0.0047	0.0064	0.0081	0.0061	0.0076
	(0.0046)	(0.0046)	(0.0047)	(0.0057)	(0.0056)	(0.0056)	(0.0057)	(0.0057)
Other non-ELE	0.0036	0.0014	0.0034	0.0074*	0.0089**	0.0099**	0.0094**	0.0109**
	(0.0028)	(0.0025)	(0.0026)	(0.0031)	(0.0029)	(0.0030)	(0.0030)	(0.0029)
SPED/ESOL	0.0561**	0.0473**	0.0470**	0.0436**	0.0436**	0.0435**	0.0445**	0.0440**
	(0.0063)	(0.0058)	(0.0059)	(0.0045)	(0.0045)	(0.0045)	(0.0048)	(0.0050)
Female		0.0003	0.0002	0.0015	0.0003	0.0001	0.0003	0.0000
		(0.0020)	(0.0019)	(0.0019)	(0.0021)	(0.0021)	(0.0021)	(0.0021)
Asian		-0.0042	-0.0120	-0.0092	-0.0101	-0.0101	-0.0110	-0.0144+
		(0.0081)	(0.0081)	(0.0078)	(0.0077)	(0.0077)	(0.0077)	(0.0078)
Black		0.0274**	0.0154**	0.0166**	0.0161**	0.0154**	0.0148**	0.0121**
		(0.0031)	(0.0038)	(0.0037)	(0.0039)	(0.0038)	(0.0036)	(0.0042)
Hispanic		-0.0034	-0.0107*	-0.0090*	-0.0110**	-0.0111**	-0.0133**	-0.0174**
		(0.0042)	(0.0042)	(0.0041)	(0.0040)	(0.0040)	(0.0041)	(0.0054)
Multi/Native/Pacific		0.0368**	0.0336**	0.0337**	0.0329**	0.0325**	0.0323**	0.0328**
		(0.0061)	(0.0057)	(0.0057)	(0.0059)	(0.0060)	(0.0061)	(0.0060)
Novice		0.0684**	0.0655**	0.0647**	0.0493**	0.0486**	0.0498**	0.0472**
		(0.0049)	(0.0049)	(0.0051)	(0.0049)	(0.0050)	(0.0048)	(0.0044)
STEM Certified		-0.0201**	-0.0189**	-0.0167**	-0.0155**	-0.0150**	-0.0136**	-0.0121**
		(0.0022)	(0.0022)	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0024)
CTE Certified		0.0354**	0.0370**	0.0330**	0.0349**	0.0357**	0.0362**	0.0375**
		(0.0043)	(0.0041)	(0.0042)	(0.0040)	(0.0041)	(0.0041)	(0.0041)
SPED/ESOL Certified		0.0007	-0.0019	-0.0019	-0.0006	-0.0003	0.0001	-0.0008
		(0.0032)	(0.0032)	(0.0031)	(0.0030)	(0.0030)	(0.0030)	(0.0030)
Grad Degree		0.0283**	0.0292**	0.0290**	0.0339**	0.0339**	0.0343**	0.0352**
		(0.0024)	(0.0024)	(0.0024)	(0.0022)	(0.0022)	(0.0021)	(0.0020)
City School			0.0032	0.0076	0.0144**	0.0104+	0.0087	0.0095
			(0.0054)	(0.0061)	(0.0053)	(0.0060)	(0.0061)	(0.0061)
Suburban school			-0.0140**	-0.0075	-0.0011	-0.0049	-0.0066	-0.0065

			(0.0048)	(0.0053)	(0.0053)	(0.0057)	(0.0058)	(0.0050)
High Minoritized			0.0108*	0.0205**	0.0233**	0.0214**	0.0216**	0.0103**
			(0.0045)	(0.0048)	(0.0048)	(0.0045)	(0.0045)	(0.0034)
High Impoverished			0.0182**	0.0170**	0.0171**	0.0177**	0.0177**	0.0177**
			(0.0033)	(0.0031)	(0.0029)	(0.0030)	(0.0030)	(0.0034)
Multiple schools in one dist.				-0.0081	0.0057	0.0071	0.0055	0.0071
				(0.0081)	(0.0069)	(0.0071)	(0.0068)	(0.0069)
Multiple districts				0.1026**	0.0841**	0.0844**	0.0862**	0.0867**
				(0.0198)	(0.0178)	(0.0178)	(0.0180)	(0.0180)
Full-time or Equivalent				-0.1852**	-0.1458**	-0.1455**	-0.1512**	-0.1518**
				(0.0159)	(0.0142)	(0.0142)	(0.0133)	(0.0133)
FTE Flag				0.3501**	0.3295**	0.3294**	0.3352**	0.3368**
				(0.0167)	(0.0151)	(0.0151)	(0.0143)	(0.0143)
Student Enrollment per 10K				-0.0002**	-0.0001**	-0.0002**	-0.0002**	-0.0002**
				(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Percent Female				-0.0009*	-0.0009*	-0.0009*	-0.0009**	-0.0009*
				(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0003)
Inf-adj Total Salary per $10K					-0.0125**	-0.0129**	-0.0117**	-0.0118**
					(0.0012)	(0.0013)	(0.0012)	(0.0012)
Total Salary flag					0.0950**	0.0960**	0.0935**	0.0938**
					(0.0136)	(0.0137)	(0.0124)	(0.0123)
Rel. Urbanicity (percentile)						0.0002*	0.0002*	0.0004*
						(0.0001)	(0.0001)	(0.0002)
Constant	0.1555**	0.1332**	0.1191**	0.3374**	0.3796**	0.3686**	0.3673**	0.3571**
	(0.0042)	(0.0036)	(0.0030)	(0.0193)	(0.0199)	(0.0191)	(0.0193)	(0.0218)
Observations	425210	425210	425210	425210	425210	425210	425210	425210
Adjusted R-squared	0.0019	0.0085	0.0099	0.0186	0.0219	0.0220	0.0238	0.0255
AIC	357260.0263	354434.4191	353836.9356	350077.9198	348649.9665	348608.6699	347834.5959	346982.5461
BIC	357314.8280	354598.8242	354045.1821	350351.9283	348945.8956	348915.5593	348141.4854	347289.4356

Note: + p < 0.10, * p < 0.05, ** p < 0.01. District-level clustered standard errors are in parentheses. The reference group includes teachers who teach non-SPED/ESOL elementary, who are male, White, having over three years of teaching experience, not STEM-, CTE-, or SPED/ESOL-certified, who do not have a graduate degree, who are employed in a NCES-categorized rural/town school, a school whose percent of students of color is lower than the median percent of students of color relative to other schools in the state (i.e., low-minoritized), a school whose percent of students eligible for FRPL is lower than the median percent of students eligible for FRPL relative to other schools in the state (i.e., low-impoverished), and who are employed in one single school within one single district in the present school year. Detailed variable descriptions are provided in Appendix Table A1.

Appendix Table C4. Primary regression: The factors of Kansas teacher turnover

	Overall Turnover	School Switcher	District Switcher	Leaver
STEM	0.0203**	-0.0022	0.0139**	0.0136**
	(0.0030)	(0.0024)	(0.0017)	(0.0026)
CTE (non-STEM)	0.0076	-0.0064**	0.0066**	0.0076
	(0.0057)	(0.0022)	(0.0023)	(0.0052)
Other non-ELE	0.0109**	-0.0055*	0.0095**	0.0089**
	(0.0029)	(0.0024)	(0.0013)	(0.0020)
SPED/ESOL	0.0440**	0.0131**	0.0118**	0.0304**
	(0.0050)	(0.0028)	(0.0024)	(0.0037)
Female	0.0000	-0.0013	-0.0087**	0.0084**
	(0.0021)	(0.0010)	(0.0013)	(0.0016)
Asian	-0.0144+	0.0002	-0.0045	-0.0127
	(0.0078)	(0.0038)	(0.0063)	(0.0078)
Black	0.0121**	0.0076**	-0.0167**	0.0206**
	(0.0042)	(0.0028)	(0.0033)	(0.0037)
Hispanic	-0.0174**	0.0025	-0.0069**	-0.0170**
	(0.0054)	(0.0021)	(0.0025)	(0.0045)
Multi/Native/Pacific	0.0328**	0.0051*	0.0017	0.0319**
	(0.0060)	(0.0025)	(0.0041)	(0.0056)
Novice	0.0472**	0.0077**	0.0390**	0.0139**
	(0.0044)	(0.0014)	(0.0046)	(0.0023)
STEM Certified	-0.0121**	-0.0014	-0.0042**	-0.0087**
	(0.0024)	(0.0012)	(0.0012)	(0.0023)
CTE Certified	0.0375**	0.0018	-0.0056**	0.0445**
	(0.0041)	(0.0012)	(0.0019)	(0.0038)
SPED/ESOL Certified	-0.0008	0.0076**	0.0065**	-0.0128**
	(0.0030)	(0.0020)	(0.0016)	(0.0024)
Grad Degree	0.0352**	0.0041**	0.0042**	0.0323**
	(0.0020)	(0.0013)	(0.0009)	(0.0018)
City School	0.0095	0.0035	-0.0037+	0.0110**
	(0.0061)	(0.0044)	(0.0021)	(0.0040)
Suburban School	-0.0065	-0.0003	-0.0024	-0.0046
	(0.0050)	(0.0031)	(0.0017)	(0.0035)
High Minoritized	0.0103**	0.0074**	0.0007	0.0042
	(0.0034)	(0.0019)	(0.0016)	(0.0027)

High Impoverished	0.0177**	0.0103**	0.0049**	0.0071**
	(0.0034)	(0.0026)	(0.0012)	(0.0023)
Multiple schools in one dist.	0.0071	0.0318**	0.0189**	-0.0377**
	(0.0069)	(0.0065)	(0.0026)	(0.0047)
Multiple districts	0.0867**	-0.0041	0.1364**	-0.0022
	(0.0180)	(0.0069)	(0.0150)	(0.0164)
Full-time or Equivalent	-0.1518**	-0.0634**	0.0135**	-0.1449**
	(0.0133)	(0.0092)	(0.0048)	(0.0122)
FTE Flag	0.3368**	0.1560**	0.1184**	0.3073**
	(0.0143)	(0.0249)	(0.0171)	(0.0189)
Student Enrollment per 10K	-0.0002**	-0.0002**	-0.0000**	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Percent Female	-0.0009*	-0.0005*	-0.0001	-0.0005+
	(0.0003)	(0.0002)	(0.0002)	(0.0003)
Inf-adj Total Salary per $10K	-0.0118**	-0.0031**	-0.0081**	-0.0044**
	(0.0012)	(0.0007)	(0.0009)	(0.0013)
Total Salary flag	0.0938**	0.0025	0.0173**	0.0885**
	(0.0123)	(0.0039)	(0.0029)	(0.0113)
Rel. Urbanicity (percentile)	0.0004*	0.0007**	-0.0002**	0.0001
	(0.0002)	(0.0001)	(0.0001)	(0.0001)
Constant	0.3571**	0.0828**	0.0936**	0.2564**
	(0.0218)	(0.0140)	(0.0106)	(0.0190)
Observations	425210	368474	369541	399661

Note: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$. District-level clustered standard errors are in parentheses. County and year fixed effects are employed. The reference group includes teachers who teach non-SPED/ESOL elementary, who are male, White, having over three years of teaching experience, not STEM-, CTE-, or SPED/ESOL-certified, who do not have a graduate degree, who are employed in a NCES-categorized rural/town school, a school whose percent of students of color is lower than the median percent of students of color relative to other schools in the state (i.e., low-minoritized), a school whose percent of students eligible for FRPL is lower than the median percent of students eligible for FRPL relative to other schools in the state (i.e., low-impoverished), and who are employed in one single school within one single district in the present school year. Detailed variable descriptions are provided in Appendix Table A1.

Appendix Table C5. Interaction regression: Turnover and salary differential associations by teacher type

	Overall Turnover	School Switcher	District Switcher	Leaver
Inf-adj Total Salary per $10K	-0.0085**	-0.0046**	-0.0071**	-0.0002
	(0.0011)	(0.0010)	(0.0010)	(0.0011)
STEM	0.0950**	-0.0094+	0.0286**	0.0917**
	(0.0109)	(0.0051)	(0.0072)	(0.0085)
CTE (non-STEM)	0.0031	-0.0286**	0.0138	0.0143
	(0.0154)	(0.0056)	(0.0110)	(0.0130)
Other non-ELE	0.0254**	-0.0277**	0.0161**	0.0380**
	(0.0091)	(0.0041)	(0.0053)	(0.0076)
SPED/ESOL	0.0983**	0.0129	0.0281*	0.0956**
	(0.0138)	(0.0095)	(0.0137)	(0.0118)
STEM # Inf-adj Total Salary/$10K	-0.0110**	0.0012	-0.0022*	-0.0115**
	(0.0016)	(0.0009)	(0.0009)	(0.0012)
CTE (non-STEM) # Inf-adj Total Salary/$10K	0.0003	0.0033**	-0.0011	-0.0014
	(0.0022)	(0.0009)	(0.0014)	(0.0019)
Other non-ELE # Inf-adj Total Salary/$10K	-0.0024+	0.0033**	-0.0010	-0.0045**
	(0.0014)	(0.0007)	(0.0007)	(0.0011)
SPED/ESOL # Inf-adj Total Salary/$10K	-0.0081**	0.0001	-0.0024	-0.0097**
	(0.0019)	(0.0013)	(0.0020)	(0.0016)
Female	-0.0001	-0.0012	-0.0087**	0.0082**
	(0.0022)	(0.0011)	(0.0013)	(0.0016)
Asian	-0.0134+	0.0003	-0.0043	-0.0118
	(0.0078)	(0.0038)	(0.0063)	(0.0079)
Black	0.0121**	0.0077**	-0.0167**	0.0205**
	(0.0042)	(0.0028)	(0.0033)	(0.0037)
Hispanic	-0.0172**	0.0025	-0.0069**	-0.0169**
	(0.0054)	(0.0021)	(0.0025)	(0.0044)
Multi/Native/Pacific	0.0328**	0.0051*	0.0017	0.0320**
	(0.0060)	(0.0025)	(0.0041)	(0.0056)
Novice	0.0475**	0.0073**	0.0392**	0.0144**
	(0.0045)	(0.0014)	(0.0046)	(0.0023)
STEM Certified	-0.0126**	-0.0014	-0.0043**	-0.0092**
	(0.0025)	(0.0012)	(0.0012)	(0.0023)
CTE Certified	0.0378**	0.0019	-0.0056**	0.0448**
	(0.0042)	(0.0012)	(0.0019)	(0.0038)

SPED/ESOL Certified	-0.0010	0.0076**	0.0064**	-0.0130**
	(0.0030)	(0.0020)	(0.0016)	(0.0024)
Grad Degree	0.0351**	0.0042**	0.0041**	0.0322**
	(0.0020)	(0.0013)	(0.0009)	(0.0019)
City School	0.0091	0.0038	-0.0038+	0.0105**
	(0.0060)	(0.0044)	(0.0021)	(0.0040)
Suburban School	-0.0071	-0.0001	-0.0026	-0.0054
	(0.0049)	(0.0031)	(0.0018)	(0.0035)
High Minoritized	0.0101**	0.0076**	0.0007	0.0040
	(0.0034)	(0.0019)	(0.0016)	(0.0027)
High Impoverished	0.0177**	0.0102**	0.0049**	0.0072**
	(0.0034)	(0.0026)	(0.0012)	(0.0023)
Multiple schools in one dist.	0.0066	0.0320**	0.0188**	-0.0382**
	(0.0070)	(0.0065)	(0.0026)	(0.0048)
Multiple districts	0.0825**	-0.0043	0.1352**	-0.0069
	(0.0179)	(0.0067)	(0.0150)	(0.0163)
Full-time or Equivalent	-0.1526**	-0.0634**	0.0133**	-0.1453**
	(0.0136)	(0.0092)	(0.0048)	(0.0126)
FTE Flag	0.3374**	0.1559**	0.1185**	0.3077**
	(0.0144)	(0.0249)	(0.0171)	(0.0190)
Student Enrollment per 10K	-0.0002**	-0.0002**	-0.0000**	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Percent Female	-0.0009*	-0.0005*	-0.0001	-0.0005+
	(0.0003)	(0.0002)	(0.0002)	(0.0002)
Total Salary flag	0.0930**	0.0005	0.0174**	0.0889**
	(0.0123)	(0.0037)	(0.0029)	(0.0113)
Rel. Urbanicity (percentile)	0.0004*	0.0007**	-0.0002**	0.0001
	(0.0002)	(0.0001)	(0.0001)	(0.0001)
Constant	0.3379**	0.0925**	0.0876**	0.2306**
	(0.0222)	(0.0155)	(0.0110)	(0.0188)
Observations	425210	368474	369541	399661

Note: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$. District-level clustered standard errors are in parentheses. County and year fixed effects are employed. The reference group includes teachers who teach non-SPED/ESOL elementary, who are male, White, having over three years of teaching experience, not STEM-, CTE-, or SPED/ESOL-certified, who do not have a graduate degree, who are employed in a NCES-categorized rural/town school, a school whose percent of students of color is lower than the median percent of students of color relative to other schools in the state (i.e., low-minoritized), a school whose percent of students eligible for FRPL is lower than the median percent of students eligible for FRPL relative to other schools in the state (i.e., low-impoverished), and who are employed in one single school within one single district in the present school year. Detailed variable descriptions are provided in Appendix Table A1.

Appendix D - Robustness checks

Appendix D1. Logistic regression robustness checks

	Overall Turnover Exponentiated LPM	Overall Turnover Logistic	Overall Turnover Exponentiated LPM w/ Interactions	Overall Turnover Logistic w/ Interactions
STEM	1.0205**	1.1650**	1.0996**	2.0122**
	(0.0030)	(0.0250)	(0.0120)	(0.1512)
CTE (non-STEM)	1.0076	1.0647	1.0031	0.9983
	(0.0057)	(0.0443)	(0.0155)	(0.1070)
Other non-ELE	1.0110**	1.0870**	1.0257**	1.1851**
	(0.0029)	(0.0233)	(0.0094)	(0.0747)
SPED/ESOL	1.0450**	1.3452**	1.1033**	1.6544**
	(0.0052)	(0.0451)	(0.0152)	(0.1358)
Female	1.0000	1.0005	0.9999	0.9996
	(0.0021)	(0.0163)	(0.0022)	(0.0164)
Asian	0.9857+	0.9053+	0.9867+	0.9120
	(0.0077)	(0.0517)	(0.0077)	(0.0518)
Black	1.0121**	1.0784**	1.0121**	1.0779**
	(0.0043)	(0.0301)	(0.0043)	(0.0299)
Hispanic	0.9828**	0.8846**	0.9829**	0.8853**
	(0.0053)	(0.0346)	(0.0053)	(0.0346)
Multi/Native/Pacific	1.0334**	1.2451**	1.0334**	1.2451**
	(0.0062)	(0.0468)	(0.0062)	(0.0466)
Novice	1.0484**	1.3737**	1.0486**	1.3762**
	(0.0046)	(0.0390)	(0.0047)	(0.0402)
STEM Certified	0.9880**	0.9092**	0.9874**	0.9045**
	(0.0024)	(0.0179)	(0.0025)	(0.0179)
CTE Certified	1.0382**	1.3163**	1.0385**	1.3201**
	(0.0043)	(0.0375)	(0.0043)	(0.0379)
SPED/ESOL Certified	0.9992	0.9953	0.9990	0.9939
	(0.0030)	(0.0218)	(0.0030)	(0.0216)
Grad Degree	1.0359**	1.3074**	1.0357**	1.3066**
	(0.0021)	(0.0174)	(0.0021)	(0.0174)
City School	1.0095	1.0711	1.0092	1.0684
	(0.0061)	(0.0497)	(0.0061)	(0.0490)

Suburban School	0.9935	0.9413	0.9929	0.9380
	(0.0050)	(0.0376)	(0.0048)	(0.0369)
High Minoritized	1.0103**	1.0877**	1.0101**	1.0858**
	(0.0034)	(0.0290)	(0.0034)	(0.0289)
High Impoverished	1.0179**	1.1439**	1.0179**	1.1442**
	(0.0034)	(0.0285)	(0.0034)	(0.0287)
Multiple schools in one dist.	1.0071	1.1130**	1.0066	1.1088**
	(0.0069)	(0.0423)	(0.0071)	(0.0437)
Multiple districts	1.0905**	1.5447**	1.0860**	1.5152**
	(0.0196)	(0.1409)	(0.0195)	(0.1373)
Full-time or Equivalent	0.8592**	0.4220**	0.8585**	0.4192**
	(0.0114)	(0.0310)	(0.0117)	(0.0318)
FTE Flag	1.4005**	5.1011**	1.4013**	5.1294**
	(0.0201)	(0.3541)	(0.0202)	(0.3596)
Student Enrollment per 10K	0.9998**	0.9983**	0.9998**	0.9984**
	(0.0000)	(0.0003)	(0.0000)	(0.0003)
Percent Female	0.9991*	0.9938**	0.9991*	0.9937**
	(0.0003)	(0.0023)	(0.0003)	(0.0023)
Inf-adj Total Salary per $10K	0.9883**	0.9121**	0.9915**	0.9312**
	(0.0012)	(0.0081)	(0.0010)	(0.0074)
Total Salary flag	1.0983**	1.8056**	1.0975**	1.7979**
	(0.0136)	(0.0960)	(0.0135)	(0.0954)
Percentile Rel. Urbanicity	1.0004*	1.0032*	1.0004*	1.0031*
	(0.0002)	(0.0013)	(0.0002)	(0.0013)
STEM # Inf-adj Total Salary/$10K			0.9891**	0.9213**
			(0.0016)	(0.0110)
CTE (non-STEM) # Inf-adj Total Salary/$10K			1.0003	1.0075
			(0.0022)	(0.0152)
Other non-ELE # Inf-adj Total Salary/$10K			0.9976+	0.9856
			(0.0014)	(0.0094)
SPED/ESOL # Inf-adj Total Salary/$10K			0.9919**	0.9688**
			(0.0019)	(0.0118)
Constant	1.4291**	0.4948**	1.4020**	0.4416**
	(0.0312)	(0.1179)	(0.0312)	(0.1057)
Observations	425210	425210	425210	425210

Note: + p < 0.10, * p < 0.05, ** p < 0.01. District-level clustered standard errors are in parentheses. County and year fixed effects are employed. The reference group includes teachers who teach non-SPED/ESOL elementary, who are male, White, having over three years of teaching experience, not STEM-, CTE-, or

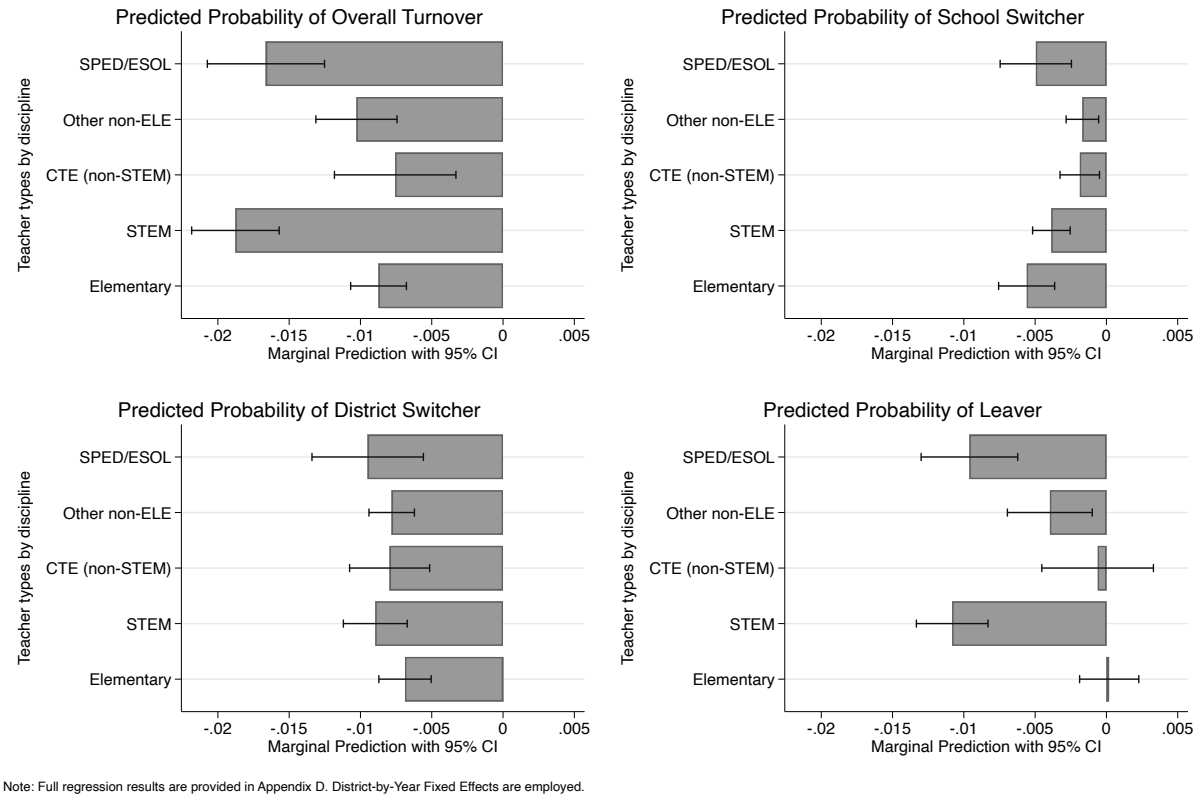
SPED/ESOL-certified, who do not have a graduate degree, who are employed in a NCES-categorized rural/town school, a school whose percent of students of color is lower than the median percent of students of color relative to other schools in the state (i.e., low-minoritized), a school whose percent of students eligible for FRPL is lower than the median percent of students eligible for FRPL relative to other schools in the state (i.e., low-impoverished), and who are employed in one single school within one single district in the present school year. Detailed variable descriptions are provided in Appendix Table A1.

Appendix D2. District-by-year Regression

	Overall Turnover	School Switcher	District Switcher	Leaver
Inf-adj Total Salary per $10K	-0.0087**	-0.0056**	-0.0069**	0.0002
	(0.0010)	(0.0010)	(0.0009)	(0.0011)
STEM	0.0882**	-0.0121*	0.0273**	0.0875**
	(0.0104)	(0.0049)	(0.0071)	(0.0083)
CTE (non-STEM)	-0.0033	-0.0312**	0.0125	0.0104
	(0.0149)	(0.0055)	(0.0105)	(0.0128)
Other non-ELE	0.0201*	-0.0308**	0.0148**	0.0355**
	(0.0089)	(0.0040)	(0.0052)	(0.0078)
SPED/ESOL	0.0972**	0.0099	0.0292*	0.0963**
	(0.0136)	(0.0100)	(0.0134)	(0.0117)
STEM # Inf-adj Total Salary/$10K	-0.0100**	0.0017*	-0.0021*	-0.0110**
	(0.0015)	(0.0008)	(0.0009)	(0.0012)
CTE # Inf-adj Total Salary/$10K	0.0012	0.0037**	-0.0011	-0.0008
	(0.0020)	(0.0009)	(0.0013)	(0.0018)
Other non-ELE # Inf-adj Total Salary/$10K	-0.0015	0.0039**	-0.0009	-0.0042**
	(0.0014)	(0.0007)	(0.0007)	(0.0012)
SPED/ESOL # Inf-adj Total Salary/$10K	-0.0079**	0.0006	-0.0026	-0.0098**
	(0.0018)	(0.0014)	(0.0019)	(0.0015)
Female	-0.0004	-0.0014	-0.0086**	0.0080**
	(0.0022)	(0.0011)	(0.0013)	(0.0016)
Asian	-0.0165*	-0.0007	-0.0044	-0.0147+
	(0.0077)	(0.0037)	(0.0062)	(0.0081)
Black	0.0096*	0.0057*	-0.0159**	0.0184**
	(0.0038)	(0.0027)	(0.0032)	(0.0036)
Hispanic	-0.0188**	0.0010	-0.0071**	-0.0174**
	(0.0053)	(0.0022)	(0.0025)	(0.0044)
Multi/Native/Pacific	0.0319**	0.0046+	0.0013	0.0321**
	(0.0061)	(0.0025)	(0.0042)	(0.0057)
Novice	0.0464**	0.0064**	0.0387**	0.0143**
	(0.0043)	(0.0014)	(0.0045)	(0.0022)
STEM Certified	-0.0123**	-0.0013	-0.0045**	-0.0087**
	(0.0024)	(0.0012)	(0.0012)	(0.0022)
CTE Certified	0.0386**	0.0024*	-0.0052**	0.0452**
	(0.0042)	(0.0011)	(0.0018)	(0.0038)

SPED/ESOL Certified	-0.0008	0.0081**	0.0063**	-0.0131**
	(0.0029)	(0.0019)	(0.0016)	(0.0023)
Grad Degree	0.0352**	0.0043**	0.0041**	0.0324**
	(0.0021)	(0.0013)	(0.0009)	(0.0019)
City School	-0.0011	-0.0028	-0.0002	0.0014
	(0.0040)	(0.0025)	(0.0016)	(0.0028)
Suburban School	-0.0023	-0.0042	-0.0001	0.0014
	(0.0040)	(0.0027)	(0.0015)	(0.0030)
High Minoritized	0.0047+	0.0023	-0.0006	0.0038
	(0.0025)	(0.0017)	(0.0013)	(0.0025)
High Impoverished	0.0110**	0.0098**	-0.0005	0.0045
	(0.0041)	(0.0022)	(0.0013)	(0.0028)
Multiple schools in one dist.	0.0039	0.0326**	0.0174**	-0.0408**
	(0.0072)	(0.0066)	(0.0027)	(0.0049)
Multiple districts	0.0795**	-0.0031	0.1367**	-0.0119
	(0.0175)	(0.0070)	(0.0150)	(0.0153)
Full-time or Equivalent	-0.1530**	-0.0629**	0.0128**	-0.1466**
	(0.0138)	(0.0091)	(0.0049)	(0.0128)
FTE Flag	0.3497**	0.1591**	0.1149**	0.3180**
	(0.0151)	(0.0248)	(0.0160)	(0.0190)
Student Enrollment per 10K	-0.0002**	-0.0002**	-0.0000**	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Percent Female	-0.0011**	-0.0006*	-0.0002	-0.0006*
	(0.0004)	(0.0002)	(0.0002)	(0.0003)
Total Salary flag	0.0908**	0.0021	0.0157**	0.0864**
	(0.0124)	(0.0039)	(0.0031)	(0.0111)
Constant	0.3923**	0.1639**	0.0717**	0.2486**
	(0.0210)	(0.0163)	(0.0112)	(0.0172)
Observations	425210	368474	369539	399660

Note: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$. District-level clustered standard errors are in parentheses. District-by-year fixed effects are employed. The reference group includes teachers who teach non-SPED/ESOL elementary, who are male, White, having over three years of teaching experience, not STEM-, CTE-, or SPED/ESOL-certified, who do not have a graduate degree, who are employed in a NCES-categorized rural/town school, a school whose percent of students of color is lower than the median percent of students of color relative to other schools in the state (i.e., low-minoritized), a school whose percent of students eligible for FRPL is lower than the median percent of students eligible for FRPL relative to other schools in the state (i.e., low-impoverished), and who are employed in one single school within one single district in the present school year. Detailed variable descriptions are provided in Appendix Table A1.



Appendix Figure D1. District-by-year salary margins by teacher type