The Retention of Novice Science Teachers in U.S. School Districts: Findings from A Cross-Case Analysis

Douglas Larkin[1], Suzanne Poole Patzelt[2], Mayra Muñoz[1], Manar Hussein[1],

[1]Montclair State University, Montclair, NJ, USA

[2]Touro University, New York, NY, USA

NARST Annual Conference

March 18-22, 2024

Denver, Colorado

Douglas Larkin https://orcid.org/0000-0001-6564-0605

Suzanne Patzelt https://orcid.org/0000-0001-8967-0657

We have no known conflict of interest to disclose.

Correspondence concerning this article should be addressed to Dr. Douglas Larkin, Montclair State University, 1 Normal Avenue, Montclair, New Jersey 07043, larkind@montclair.edu

This material is based on work supported by the National Science Foundation under Grant #1758282. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

The Retention of Novice Science Teachers in U.S. School Districts:

Findings from A Cross-Case Analysis

For many years, the focus of research on teacher careers has been on identifying the reasons why teachers leave the profession, in order to provide interventions that mitigate the problems. Alternately referred to as *teacher attrition* or *teacher turnover*, these efforts have uncovered some of the systemic difficulties faced by teachers in their work lives and have provided important empirical support for improving not only the work lives of teachers, but the experiences of students as well. The problem of teacher attrition—or teacher turnover—is framed primarily by those who are charged with ensuring that there is a "good teacher in every classroom" (Darling-Hammond et al., 2005) because there are few problems more vexing to an administrator than staffing shortages. In the United States, this is particularly true in areas of perennial teacher vacancies, such as in secondary science subjects like biology, chemistry, and physics, where there is no guarantee that an open position can be filled in a timely manner.

Yet, this construction of the problem of teacher attrition as motivated primarily by figuring out why teachers leave has foregrounded the act of leaving and normalized the act of staying. Perhaps this is because it is natural to conflate the fact of someone staying with the internal state of wanting to stay. In other words, a common assumption in thinking about teachers who stay is that they are different from the teachers who leave, because whatever reasons there are for leaving do not necessarily impact them to the same extent. In the present study, we question this assumption right from the outset, and posit that the reasons people stay are not simply the inverse of the reasons people leave.

If job satisfaction is the explanatory framework for leaving or staying, then teachers who stay are satisfied and teachers who leave are not. In fact, it only takes the briefest of thought experiments to consider cases where someone who is very unsatisfied with their teaching job might stay (perhaps the job is a financial lifeline that cannot be risked in any way), and someone who is very satisfied might leave (perhaps if a partner is offered a dream job on the other side of the country and a move is necessary). In the larger human resource literature, it turns out that the construct of job satisfaction has very little predictive power in predicting attrition, even while ensuring employee satisfaction with their jobs remains a key aspect of creating a sustainable working environment.

The literature has identified both personal and organizational factors related to teacher retention. Some personal factors such as age and sex seem to offer limited explanatory power with respect to retention, while others such as race/ethnicity, education level, and teacher preparation pathways and components do appear to have some predictive power. Certainly, these factors interact with organizational and contextual factors that appear related to retention, such as the adequacy of salary, teacher autonomy, respect in organizational culture, and opportunities for professional growth. We have argued elsewhere that teacher attrition and mobility are different concepts, and that care needs to be taken when defining teacher retention, especially when comparing across different contexts (Larkin, Patzelt, et al., 2022).

New teachers are of particular concern when considering issues of retention, as there are a number of reasons why new teachers are more likely to leave the profession than experienced teachers. A new teacher may realize that teaching is not what they expected it to be, or find it personally challenging in unexpected ways. New teachers also tend to be young adults, when life circumstances tend to be less certain and new opportunities or personal circumstances may arise. A new teacher may simply not meet expectations with respect to the professional skills or attributes required of them, and fall short of teacher quality measures or opportunities to improve. Across nearly all organizational contexts and policy environments, it appears more likely that an 11th-year teacher will return to be a 12th-year teacher, than a first-year teacher will return for a second year. While this may not be unique to teaching as a profession, given the fact that in the United States educators form one of the largest groups of employees—over 3 million people, or 1% of the U.S. population work in education—as well as teachers' daily relevance to everyone who is a caregiver to a school-aged child, the retention of new teachers is an issue of high visibility to the general population in the United States. In some districts where the average experience of the teaching faculty is less, the effects of teacher attrition and mobility are keenly felt for this reason.

One of the key strategies arising from the teacher professionalization policy changes of the 1980s has been the institutionalization of practices relating to supporting new teachers within the school districts and settings into which they are hired. Two important efforts—often conflated in practice—are mentoring and induction programs. We review these concepts further below, but broadly our definition of mentoring concerns efforts that connect newly-hired and experienced individual teachers, while induction programs are more systematic and aimed at providing organizational resources to address the needs of new teachers. For decades, mentoring and induction programs have been considered key practices in state and district efforts to retain teachers, and have sometimes been justified by their subsequent impact on student learning, even if the evidence has been thin. In many ways, the common-sense notion that a new professional in any profession needs support appears to have been the buoyant force keeping such practices afloat for the past few decades.

Despite key practices to retain teachers, the persistent shortage in secondary science and mathematics teachers has led to a reassessment of current efforts for teacher retention. Ingersoll has repeatedly noted that the supply of new science and mathematics teachers would likely be sufficient if the flow of such teachers out of the profession could be addressed.[1] Our research team's expertise and experience in secondary science teaching led us to focus solely on this population of teachers, and we sought to do so in districts that had demonstrated novice science teacher retention longitudinally with multiple cohorts of new teachers. We also wished to ensure that we had enough variation in state policy contexts to be able to properly attribute differences across schools within a state. As described below, we ultimately selected four states for the selection of high-retention districts: New Jersey, North Carolina, Pennsylvania, and Wisconsin. In this study we aimed to investigate a wide range of factors related to teacher retention.

The primary question we investigated in our research was, **"In districts that have demonstrated comparatively more successful novice science teacher retention, what are the factors that relate to such retention?"** We sought to understand what retention efforts were

[1] The National Science Foundation took up this challenge by creating a funding source for researching STEM teacher recruitment, preparation, and retention through its Noyce Teacher Scholarship Program, which served as the funding source for the present study.

working to retain novice science teachers across the schools in each state, but given the priorities of the Noyce program, we also specifically looked for districts that were successfully retaining teachers of color, as well as high-need schools that were also successful in retaining teachers.[2]

As a research team, we had a number of methodological and ethical commitments from the outset. First, the focus on why novice science teachers stayed, rather than why they leave was important because the pathological approaches taken in prior research on teacher attrition had borne limited fruit, and we felt that a "search for the good" in educational research was likely to produce new insights. In order to do this, we had to be rigorous in identifying places where novice science teachers were being retained, and ensure that we were using trustworthy data on teacher staffing to identify retention. Yet, we also recognized that quantitative or survey data could only tell us so much, and that we had to be open to collecting qualitative data—through case study methods— to capture the richness of the stories about teacher retention that were conveyed to us by our participants.

A related commitment of our project was respecting and valuing the knowledge of educators. It was clear to us from our own experiences as classroom teachers that educators often have a wealth of knowledge and practical wisdom that often goes unrecognized outside of their own contexts. We took it as a given that administrators and teachers had developed practices that fostered teacher retention, and that part of our role as educational researchers was to bring their hard-won knowledge to a wider audience. It also meant that we shared our analyses and opened ourselves to their feedback.

This study was conceived and designed prior to the start of the global COVID-19 pandemic, and the first site visits took place in early 2020 just before schools began going remote out of safety concerns. Though we initially planned for a larger sample, we also had to respect district administrators' choice not to participate in the project—and nearly all who declined participation did so out of concern for the ongoing stress on their teachers during this time. Ultimately, we conducted 13 case studies on high-retention districts, and the purpose of the present paper is to present the findings of the cross-case analysis to share our answer to the question of what is working in efforts to retain novice science teachers.

Review of the Literature

In this section, we review the literature for the factors that are currently considered important for teacher retention. The section ends with a brief overview of the ways in which school and district context factors are portrayed in this literature with respect to teacher retention. The practice of mentoring and induction for novice teachers, as a specific approach for supporting teachers, will be treated separately and through the lens of teacher retention.

We begin this section with careful attention to the ways in which teacher retention and its associated terms have been characterized in the literature. One of the findings from our research team's prior analysis of teacher retention literature was the need to specify the duration of

---

2

In the program solicitation for this grant (NSF 17-541) NSF defines "high-need" from section 201 of the Higher Education Act of 1965 (20 U.S.C. 1021) to mean "a local educational agency (for example, a school district) that serves an elementary or secondary school located in an area which is characterized by at least one of the following: (a) a high percentage of individuals from families with incomes below the poverty line; (b) a high percentage of secondary school teachers not teaching in the content area in which they were trained to teach; or (c) a high teacher turnover rate." All of the LEAs meeting this "high-need" definition in our study were identified as such by the percentage of students receiving free or reduced lunch in 2017-18.

retention envisioned in research so that results could be compared across studies. For the purposes of this research, we considered the five-year point an adequate benchmark by which to ascertain whether a teacher was retained in their district of employment. Further, because the district (or Local Educational Authority, in the parlance of U.S. educational policy that is inclusive of charter, vocational, and special services schools) is our unit of analysis, we considered a teacher to be retained as long as they remained a teacher employed by the same employer. We recognize that to an administrator who has to hire a replacement for a teacher who has shifted to a school across town, it may not seem as if that teacher was retained, but our definition of retention is with respect to the employer, and by extension, the profession of teaching.

For our study, we have chosen to view retention as finishing five years and starting a sixth for a few reasons. First, according to the U.S. Department of Labor, the median number of years that wage and salary workers have been with their current employer is a little over 4 years, though for education, training, and library occupations it is a little over 5 years. By defining "retention" in our study as completing a fifth year and starting a sixth, we are really looking to see if a given teacher stays as long as the average employee. Also, in states with tenure, this time marker also ensures that teachers have had the opportunity to earn the rights and job security of tenure—which is 3 or 4 years in most places—so in a way this reflects the field's view of when a teacher is no longer considered a "new" teacher. Finally, a six-year span seems a reasonable amount of time to allow for new teachers who take time off for family or medical purposes (about 13% of new teachers in our preliminary analysis) to return to the workforce, and not be counted as teachers who have left the profession. In our determinations of retention, we have found that sometimes employment is not counted in whole years, or that the line between long-term substitute teacher and full-time teacher can be difficult to tease apart. Therefore, even though we mark five years as the retention point, we can only say with certainty that the individual teacher has taught at least four full years within that period of time. As noted in our previous scholarship on this topic (Larkin, Patzelt, et al., 2022), we intentionally avoid the use of the term "teacher turnover" because of its imprecision.

In this study, we drew from Ingersoll and Strong (2011) to define *induction* as a set of systemic programmatic efforts designed to support new teachers during their first five years of teaching. Dawson's (2014) typology of mentoring does include models that might be considered equivalent to induction, but in this study, we defined *mentoring* to be a one-to-one relationship between one less experienced teacher and one with more experience. Within this definition there are certainly a wide range of approaches and models for how, when, and where mentoring takes place.

Teacher Retention Factors

Over the past two decades, there has been a fundamental reconceptualization about the shortage of science teachers in U.S. schools. For a long time, the problem was considered to be one of recruitment, but a sustained program of research led primarily by Ingersoll's detailed investigation of multiple decades of data from the School and Staffing Survey has led to the finding that the labor shortages in middle and high school science and mathematics teachers is driven primarily by teacher attrition and mobility (Ingersoll, 1997, 2007, 2011; Ingersoll & May, 2011, 2012; Ingersoll & Smith, 2003). Recruitment remains an important link in the process of addressing this shortage, particularly in chronically hard to staff areas of certification such as science, mathematics, special education, and bilingual education (Barth et al., 2016).

A great deal of prior work on teacher retention has focused on the labor pool for teachers, and specifically the question of whether teachers survive their first year and return for a second. The methodology for this program of research required a national sample of teachers to make broader generalizations about the labor pool of teachers. This remains an important avenue of research, and a few key insights of this work serve as a starting point for our project, including:

- Science and mathematics teachers leave the profession at about the same annual rate as teachers in other subject areas.
- The new supply of qualified mathematics and science teachers has been more than sufficient to cover those retiring.
- The issue of teacher turnover seems more pressing in math and science because there are fewer un-hired teachers out in the labor pool in these areas.
- Few of the measured individual characteristics of first-year teachers were related to their likelihood of leaving.
- First-year teachers who took more courses in teaching methods and strategies were significantly less likely to depart.
- Greater teacher autonomy is connected to reduced turnover in low-performing schools.

Literature on the determinants of science and mathematics teacher attrition has identified variables that contribute to teacher attrition such as discipline, classroom management, poor administrative support, contradictions between theory and practice, scheduling, and socialization (Saka et al., 2013). Qualitative and quantitative studies have examined the characteristics of teachers' context that influence intrinsic and extrinsic factors leading to attrition and migration from science and mathematics(Borman & Dowling, 2008; Guarino et al., 2006; Ingersoll & May, 2012; Ingersoll & Perda, 2010; Ingersoll & Strong, 2011).

Research that draws upon organizational theory identifies major trends that impact both attrition and retention, which includes: individual difference (e.g., personality, motivating forces), increased emphasis on contextual variables with an emphasis on interpersonal relationships (e.g., leader-member exchange, interpersonal citizenship behaviors), enhanced focus on factors looking specifically at staying; and dynamic modeling of processes with the consideration of time (e.g., changes in job satisfaction), and financial incentives (Fulbeck & Richards, 2015; Holtom et al., 2008; Ingersoll & May, 2012).

It has long been recognized that school and district contexts play a significant role in not only student experiences and outcomes, but in the teachers' work lives as well. Issues as widely ranging as school funding, racial integration, school size, the physical conditions of buildings, school climate, the ages and grade-levels of students, degree of curricular and professional autonomy, administrative support, the local character of the community, and the relationship between the individual school and other organizational characteristics may all be considered part of this context. Throughout the teacher retention literature, these contextual factors appear to play a very important role in determinations to stay. For example, Nguyen (2021) notes a strong correlation between teacher retention and administrative support while a study in Sweden emphasized social support from colleagues as an important factor (Casely-Hayford et al., 2022).

Mentoring and induction

Understanding the role of induction and mentoring programs in retaining science teachers remains an important yet under-researched aspect of ensuring that well-prepared teachers stay in the profession. In recent years, greater attention has been drawn to the issue of supporting new teacher learning in their first years of teaching—a period commonly referred to as *induction* (Feiman-Nemser, 2001). The professional needs and challenges of science teachers specifically during these induction years are well documented in the literature (Bianchini & Brenner, 2010; Davis et al., 2006; Saka et al., 2009; Wood et al., 2012), and include improving subject matter knowledge (Abell, 2007), developing a professional identity (Kelly, 2006), learning about students, specific instructional practices, and professionalism. One core finding concerns the positive value of discipline-specific induction support for novice science teachers (Luft et al., 2003).

Yet, in a large randomized controlled trial of induction in a sample of large, urban, low-income schools that indicated significant positive effects on student achievement were correlated with teachers involved in induction programs; there were no effects on either teacher retention or teachers' classroom practices (Ingersoll & Strong, 2011), and a similar absence of effect of induction on retention was noted in another large-scale study as well (Isenberg et al., 2009). These findings are counterintuitive and point to a need to better understand the relationship between specific types of induction support during the first years of teaching and retention in the profession.

Despite broad recognition of its importance, the shortcomings of mentoring or induction efforts are a reality for many new teachers. It is not uncommon for new teachers to work in isolation from colleagues and be left on their own to succeed or fail despite being placed in the most challenging and difficult classrooms and schools (Ingersoll & Strong, 2011). This "sink-or-swim" theory of teacher learning runs counter to decades of research on teacher learning (Feiman-Nemser, 2001, 2012), particularly concerning the widely understood role of the necessity of feedback for learning (Hattie & Timperley, 2007). Rather than leaving new teacher success to chance, the field of teacher preparation has recognized that the function and structure of induction are now critically important and areas of further research.

Aspects of induction that require greater scrutiny are the mentor-mentee relationship and the process of becoming a reflective teacher in a professional learning community, particularly as these relate to equity (Achinstein & Barrett, 2004; Zeichner & Liston, 1996). Individual schools' mentoring programs vary based on constraints such as the number of teachers they serve, release time to develop the mentor-mentee relationship, and the mentor's areas of expertise, among others—thus raising the question, in hard-to-staff schools and districts, of what types of mentoring programs exist, and what constitutes a "good" mentoring program to support teacher retention.

Currently, some states such as Massachusetts and California have coherent and robust programs of induction for new teachers, influenced by research-based models of induction, such as those published by The New Teacher Center. However, many nationally recognized programs of science teacher induction like the Knowles Science Teaching Foundation (Galosy & Gillespie, 2013; Trygstad & Banilower, 2015) and The Exploratorium in San Francisco (Shore & Stokes, 2006) only reach a limited number of teachers and have a specific focus on developing science teacher leadership. It is clear that even in states with existing requirements for mentoring during the first year, like New Jersey, there is little to no data on the effectiveness of various types of support during the first years of science teaching. The proposed study will address this gap by examining the induction and mentoring programs of a much wider sample of districts across multiple states, and in greater detail.

Much of the contemporary literature around science teacher induction and mentoring has focused on describing or comparing different models of induction (Ceven McNally, 2016; Luft et al., 2011; Luft et al., 2003; Roehrig & Luft, 2006) or providing individual case studies of teacher learning during an induction program (Bang & Luft, 2014; Galosy & Gillespie, 2013; McGinnis et al., 2004; Ortega et al., 2013; Saka et al., 2013; Saka et al., 2009; Sickel & Friedrichsen, 2015; Soares et al., 2008). While these studies are quite valuable in both mapping out the developmental pathways and learning progressions for new science teachers, they are also limited in being able to inform policy, and may overlook current locally developed efforts that have had positive results on either student learning or teacher retention.

One of the clearest visions of the theory of teacher induction was offered over two decades ago by Feiman-Nemser (2001), who set clear developmental and professional benchmarks for teacher learning during the first five years of employment. These included: gaining local knowledge of students, curriculum, and school context, designing responsive curriculum and instruction, enacting a beginning repertoire in purposeful ways, creating a classroom learning community, developing a professional identity, and learning in and from practice. However, the interactions between all of these components are still not well understood and it has been difficult for researchers to characterize a more fine-grained developmental pathway or learning progression for teachers. Often, the available resources for mentoring are concentrated in the first year (as is the case in NJ), and this ambiguity over what sorts of issues ought to gain precedence in mentoring has left many induction programs operating without a clear curricular approach or even learning objectives.

Theoretical Framework

To make sense of our data, we chose to theorize teacher retention by using an adapted version of the framework of job embeddedness (Holtom et al., 2006; Kiazad et al., 2015; Mitchell et al., 2001), which we have borrowed from the field of applied psychology and economics. This adapted theory, which we have termed teacher embeddedness (Larkin, Carletta, et al., 2022), offers new insights on meaningful support for novice teachers and is consistent with our aim to focus on why teachers stay, rather than why they leave (Lee et al., 2014).

As shown in Table 1, the main components of teacher embeddedness theory are fit, links, and assets, and are applied to two distinct domains: the organization and the community (Larkin, Carletta, et al., 2022). In our teacher embeddedness framework, the organization refers to the workplace of the school and district itself, and community refers to the local area surrounding the school. In our research, we seek evidence of fit, links, and assets in both these domains.

Fit refers to the comfort and compatibility of an individual to the organization and community, and includes the degree to which the goals, values, and worldviews of the employee are aligned with those in evidence in those domains (Holtom et al., 2006; Watson, 2018). It also includes the degree to which there are emotional attachments and aspirational commitments to these workplaces and settings. Simply put, new science teachers who may flourish in some environments might find it difficult to continue in others. In their study, Zumwalt et al (2017) note, “Finding the right match, regardless of the type of school, seems to be the critical factor for many of the teachers who chose to remain in classroom teaching,” (p.18).

Links are formal and informal social connections and relationships. Within the workplace these links may be to colleagues and associated professionals. Within the local area, these links may include family, religious, and other social affiliations. Links with students and their families are also important and may span the boundary between organization and community. Certainly, such links may also influence a person's decision not to leave their place of employment (Mitchell et al., 2001). Links are often stronger when the district is familiar to a teacher. Reininger (2012) found that most young teachers in the United States live in close proximity to their hometowns, and Redding (2022) found that homegrown teachers from urban districts do tend to remain longer.

Table 1. Teacher embeddedness theory from Larkin et al., (2022), adapted from Mitchell et al. (2001) and Holtom, et al. (2006)

Component	Domain: Organization	Domain: Community
Fit	The comfort and compatibility of an individual with respect to the local educational context. This includes the degree to which the aspirations, career goals, values, culture, and worldview of the teacher are aligned with the environment of the local educational context in which an individual works.	The comfort and compatibility of an individual with respect to the community. This includes the degree to which the aspirations, career goals, values, culture, and worldview of the teacher are aligned with the environment of the local community in which an individual works.
Links	Personal relationships and connections made with colleagues, students, and others within the local educational context.	Personal relationships and connections made with individuals and groups within the community, which may include family, consumer, religious, and other social affiliations.
Assets	The sum of the tangible and intangible benefits from a job to an individual in terms of perceived material and psychological value. Such assets may include salary, workplace space and materials, perquisites, established patterns of working, and support for professional growth.	The sum of the tangible and intangible benefits from a community to an individual in terms of perceived material and psychological value. Such assets may include housing, sense of place, established patterns of living, personal safety, favorable commutes to work, and other aspects of one's quality of life influenced by the community.

The third component of the teacher embeddedness framework, *assets*, refers to the tangible and intangible benefits from a job to an individual in terms of perceived material and psychological value. We describe as assets those things which would be sacrificed if an educator voluntarily left a position (Larkin, Carletta, et al., 2022).

Methodology

This study consisted of two distinct phases. In the first phase, we used publicly available data to track the retention of individual secondary science teachers in four states over a ten-year period. Using these data, we then identified candidate districts/LEAs for further case study based on their record of retention in the focus areas. In the second phase, we identified and then recruited districts with a high rate of novice science teacher retention to participate in a site visit and qualitative data collection. The data from this visit was then analyzed to construct a written case study to describe the factors influencing teacher retention in each district. A multiple case analysis of the 13 complete district/LEA-level case studies was then conducted, with the goal of identifying common themes across the cases. This entailed an iterative process of using the framework to ask our questions, then looking for themes from our participants, then identifying clear connections to our framework. The methodology and data sources for each phase are described in detail below.

Phase One: Analysis of State-Level District Staffing Data for all years 2007-2018
In this section we describe the data sources and methods used to identify novice science teachers who were retained for at least four out of their first five years of teaching in a single school LEA. We limit our discussion of methods to the identification and selection of focus districts, even though we conducted a broader analysis of each state's staffing data with respect to the differences between retained and non-retained novice science teachers. The results of that analysis will be reported in a future paper.

Data Sources

In the United States, much of the research on teacher retention has tended to draw upon two types of data sources. First are the large-scale surveys of teachers produced by the National Center for Education Statistics such as the Schools and Staffing Survey (SASS) and the Teacher Follow up Survey (TFS) used between 1987 and 2011. Data from the SASS have informed a great deal of foundational research in teacher retention research in the United States, particularly the work of Richard Ingersoll and colleagues (e.g. Ingersoll, 1997, 2007, 2011; Ingersoll & May, 2011, 2012; Ingersoll et al., 2016; Ingersoll & Smith, 2003). The successor to SASS, the National Teacher and Principal Survey (NTPS) is currently used to produce an annual report on the condition of education in the U.S. (McFarland, 2019), but as of this writing has not been used to report on teacher retention. There are also smaller and more focused studies that are also survey-based, such as the NJ Pathways study of a 1987 cohort over 11 years (Natriello & Zumwalt, 2017) and the later NYC Pathways study (Boyd et al., 2006).

The second type of data source informing teacher retention research comes from smaller-scale qualitative studies that track relatively small numbers of teachers longitudinally. For example, much of the literature around science teacher induction and mentoring has focused on tracking, describing or comparing different models of induction (Ceven McNally, 2016; Luft et al., 2011; Roehrig & Luft, 2006) or providing individual case studies of teacher learning during an induction program (Bang & Luft, 2014; McGinnis et al., 2004; Saka et al., 2013). While these studies are valuable in understanding the particular experiences of novice teachers, they are somewhat limited in being able to inform policy. Given the wide range of teacher education program quality (Zeichner, 2006) and variation in district and state mentoring and induction supports (Dawson, 2014), the ability to generalize from such in-depth studies may also be limited. While such studies are crucial in grappling with equity and justice issues in education (e.g. Achinstein & Barrett, 2004; Bianchini & Brenner, 2010; Lee, 2006), they may not point to salient trends in the teacher labor force that could meaningfully influence policymakers.

In this paper, we join a growing number of researchers to make use of a new kind of dataset: state-level school staffing reports. While in certain states these reports have been available for decades, in the United States the Department of Education's Race to the Top grant proposal process from 2009-2013 brought new attention to the pressing issue of the development of longitudinal data systems (Howell & Magazinnik, 2017). As a consequence, many state-level education data systems now have unique teacher identifiers that allow for education researchers to examine questions about teacher retention (which includes teacher mobility, persistence, and attrition) at a scope and level of detail that was previously available only to state departments of education. Ultimately, the development of these systems across states was uneven, and often focused more on student achievement outcome data (Boser, 2012; Flores et al., 2017). Yet, the existence and availability of these databases gave many U.S. states the capacity to look at old questions about teacher retention in new ways. Indeed, a growing number of researchers have gained access to these or similar state-level (or even large district-level) data to research teacher retention (e.g. Bastian & Marks, 2017; Mandel et al., 2018; Marinell & Coca, 2013; Simon & Johnson, 2015).

Data contained in the state staffing reports typically includes certain common fields, such as first, middle, and last name, salary, and year of birth. Reporting of race and ethnicity have changed over the past decade, and given that states must report race and ethnicity data to the federal government, many state data systems appear to have adopted federal guidelines that allow for respondents to choose more than one race, and present ethnicity as a separate category (Spellings, 2007). Sex data is also included in this data set, and while some states have moved to include a non-binary response option for students, none of the teacher-level data examined for this study included this option. We note here that by the final data year of this project (2017-2018), the states in this study no longer published race/ethnicity or year of birth in their publicly available staffing data. Salary data may be reported differently depending on the state or year (e.g. monthly, annual, base rate, total with supplemental, etc.).

The professional data in these reports typically include educational attainment level, teaching assignments (used as a proxy for certification area), full/part time status, years of experience in the LEA, years of total teaching experience. The school and local education agency (LEA) assignment and location is also included, and may include the grade level or grand band (e.g. elementary, middle, high school) taught. Some states included a field for preparation pathway (e.g. New Jersey data provides the option for the selection of "traditional" or "alternate route").

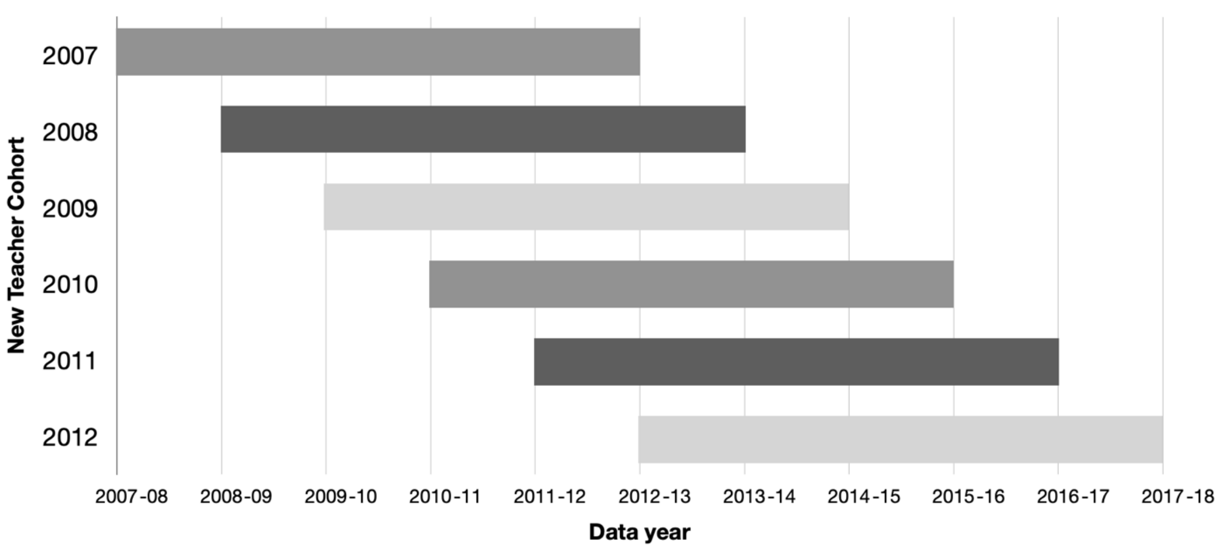
Used in combination with other district and school data made publicly available by state departments of education, it was possible to link other contextual factors such as district size, school size, and student demographics to the data on individual teachers.

The four states in this study, as shown in Table 2—New Jersey, North Carolina, Pennsylvania, and Wisconsin—were chosen because they are high-population states with diverse populations, have a mix of rural, suburban, and urban school districts, and represent a range of teacher preparation and retention policy contexts. Further, each of the four states had full and available annual data sets of teacher employment that included demographic and teaching assignment fields. Pennsylvania, and Wisconsin published their staffing lists as spreadsheets on state websites. New Jersey's data was not publicly available but was obtained through the state's Open Public Records Act process. The State of North Carolina stores all education data with the North Carolina Education Research Data Center (NCERDC), and was made available for a fee. Notably, data from North Carolina did not include teacher names, only unique numerical identifiers. Though a larger study with more states would likely have enriched our investigation, given the constraints of time, funding, and data availability we felt that the four states selected were likely to yield sufficient answers to the research questions.

Table 2. Population data for selected states in 2017 (cite US Census, NCIS)

	NJ	NC	PA	WI
Total state population	8,900,000	10,400,000	12,800,000	5,800,000
Number of Teachers	116,351	98,590	120,681	60,649
Number of secondary science teachers	~7000	~8000	~9000	~5000
Total regular local public school districts[3]	562	121	500	420
Number of LEAs with at least one novice high school science teacher between 2007-2018	242 (43%)	85 (70%)	353 (70%)	182 (43%)

Figure 1. Annual staffing data required for each cohort of novice science teachers



For each of the four states, we identified teachers who had been retained for four out of their first five years. We required six years of data because staffing data was compiled at the beginning of each state's academic year. Additionally, we examined teacher retention of multiple cohorts of novice science teachers who all began teaching in the same year. Given that complete

[3] Our data included other public school LEAs, such as county-level vocational schools and charter schools. "Regular local public school district" is a data category used by the National Center of Educational Statistics.

data was available for each of the four states beginning in 2007, and this project began in 2018, we were able to fully analyze all six cohorts, as shown in Figure 1. Therefore, we required 11 years of annual staffing data from each state, spanning from 2007 to 2018.

Creating a Master Table for Each State

The first step in this analysis was to construct a master list for each state that included the employment status of each novice science teacher who was a member of the 2007 through 2012 cohorts. Each data set was trimmed to include only teachers of secondary science who were in their first six years of teaching within this time frame, and each individual was assigned a unique project identifier that included their state and cohort year (e.g. NJ2007-001). All of the data sets for a given state were then merged and cleaned. This process entailed maintaining consistency in fields, imputing any missing data, and double checking to ensure that first-year teachers were properly identified as such. This process was time-consuming, particularly in confirming that each first-year science teacher was correctly identified. One final trim of the data excluded any teacher who was not a member of the 2007-2012 cohorts and in their first six years of teaching.

This process ultimately resulted in four master state data sets consisting of every teacher in the novice science teacher cohorts, along with their employment history. Additional data tags were assigned to each individual to characterize their "real" years of experience, and whether they were retained four of their first five years in the same LEA. Ultimately each teacher in the data set was designated with a binary indicator for their retention status. A visualization of the result of this analysis may be seen in Larkin, Patzelt, et al. (2022).

The race and ethnicity data within the original staffing reports was inconsistently reported across states and cohorts, therefore, we elected to create a binary category in order to capture whether or not a given individual was from a minoritized demographic group. The overwhelming majority of teachers in the data set were characterized as White and non-Hispanic. Indeed over 80% of the teacher workforce in the United States identifies in this manner (McFarland et al., 2019). The second group included all individuals identified as either Hispanic or non-White or both. Though these categories are problematic in many ways (Nguyen & Teranishi, 2020), and the imprecision of the phrase "teachers of color" threatened to introduce new errors, we did ultimately assign teachers to a binary category of whether they were White and non-Hispanic (0) or not (1). This approach seemed a reasonable choice given our purpose of analyzing the data through the lens of race and ethnicity to identify districts that were successfully retaining teachers who reflected the demographic profile of their students. However, there is no guarantee that individual teachers themselves were consulted for how they identified racially or ethnically.

Phase Two: District-level Investigation of Teacher Retention Factors

In the second phase of our study, we identified districts that we deemed to be successful in retaining novice science teachers and investigated the factors that appeared to influence this outcome. In this section, we discuss the selection of focus districts and their subsequent recruitment into the study. We then detail our qualitative data sources and methods and construction of the individual cases. We conclude this section with a brief discussion of the cross-case analysis in our effort to identify generalizable and actionable findings.

Case study district selection

Our research team created a retention index measure as a first step in identifying potential districts of interests. Six factors were weighted equally in this index: top 10% in a rank of total number of novice science teachers retained, top 10% in a rank of the ratio of novice science teachers retained to student population, retention of three or more novice science teachers in 11 years, retention of at least one novice science teacher of color, greater than 50% of students receiving free or reduced lunch, and top 10% in a ranking of districts by number of students identified as limited English proficient. Each of these factors was worth 1 point on the index. Districts that did not retain more than 50% of its novice teachers were excluded, as were districts that only retained one novice science teacher in 11 years.

From this initial index, we identified a subset of districts in each state that demonstrated high retention rates for novice science teachers for possible further qualitative study. In selecting this subset of districts, we sought to balance our opportunity to learn (Stake, 2005; Stake, 1995) by including a number of factors such as the district's geographic location in the state, districts that demonstrated success in retaining science teachers of color, and the demographic profile of the school, which included the percentage of students receiving free/reduced lunch or were designated limited English proficiency. This selection process involved the entire research team in deliberation, and was repeated for each state. For each state we selected five target districts for invitation, and another five districts as suitable backups in the case that an invited district declined our invitation to participate in the study.

After an initial email and/or phone call invitation to the study, the principal investigator and project manager typically met with district leadership to discuss the study, and begin the process of local project approval, typically through a director of research or review board prior to full school board approval. Though we had aimed for 20 cases total (5 for each state), even with inviting our backup districts, we were unable to obtain permission and conduct research in districts focused on essential functions and key personnel fell ill or left their positions. A total of 13 districts in all four states agreed to participate in the study.

Qualitative Data Collection

The research team scheduled a site visit and interviews with teachers, science area supervisors, administrators, and other district personnel involved in supporting novice science teachers. In each district, a liaison typically aided in arranging and scheduling the interviews. Site visits prior to March 2020 and after April 2022 were conducted in-person at district schools, while those during the intervening time were conducted virtually over the Zoom online video application. Interviews took place at the convenience of the interviewees, and the consent form promised both individual and institutional confidentiality. While the majority of the interviews were individual, a number of group interviews took place by necessity. These were grouped by experience level (e.g. novice teachers, experienced teachers) and did not mix teachers and administrators in order to permit them to speak freely.

Interviews typically lasted 30-45 minutes and were recorded, transcribed, and then analyzed using NVIVO12 software. All active members of the research team collaborated on the data collection and construction of the case narrative. Other data collected included publicly available district documents on district websites. We welcomed any other documentation related to the mentoring and induction efforts that districts wished to provide as well. This additional information was used primarily for corroboration, accuracy, and detail for the written case studies.

All interviews were recorded and transcribed, and each was imported into the NVIVO12 application for further analysis. At least three members of the research team independently coded data for each case prior to a meeting to identify emerging themes related to the salient factors influencing novice science teacher retention in the district. Additionally, the mentoring and induction efforts within the district were added as a focus for each case in order to characterize the relationship between these efforts and teacher retention in the district as portrayed in the data.

Case Study Construction and Cross-Case Analysis

Active members of the research team then collaborated on constructing the narrative of the case (Stake, 1995), with a single author taking the lead on the writing of each case. When a draft of the case was ready for member-checking, a copy was sent to each person in that district who had been interviewed along with a feedback form. Of all cases, four participants responded with feedback of correction, clarification, or affirmation, and final case study text was subsequently modified to address these comments. A total of 13 cases were completed over the course of the project, and final drafts of the case studies were published on the project website.

The case studies sought to identify the most salient factors related to novice science teacher retention in each district, and the cross-case aimed to synthesize the findings across the completed cases. Though case study researchers typically caution against using a multiple-case study approach as a reliable method for producing generalizable findings, we felt that the selected focus of this investigation on practices that have been successful in one context, for possible use in another, make the effort at producing actionable suggestions from a broader analysis worth the risk of overgeneralization.

Following the procedure suggested by Stake (2006) for multiple case study analysis, our research team has analyzed the findings of each particular district case in light of the themes of this research to develop *assertions* about the multi-case as a whole. Our multiple case study analysis was conducted by having three research team members first establish inter-rater reliability by independent coding and consultation, and then proceed to code the remaining cases individually using the *a priori* categories of the previously identified retention factors in order to identify commonalities and sub-themes across the cases that comprise the assertions. Stake emphasizes the need for the evidence behind these assertions to be presented in the final report, so as to make a persuasive case to the reader, and we do so in the subsequent section.

Findings

Our analysis yielded 10 distinct categories of factors that influenced teacher retention across all of the case study districts. These themes are shown in Table 3, and though there were some elements of many of these factors in each case, our analysis focused on identifying the major factors in each district based upon the preponderance of evidence presented in the case data. Therefore we, present these factors in the order in which they appeared most frequently as major themes in the cases.

Table 3. Major teacher retention factors from the cross-case analysis

Teacher Retention Factor	Count of cases

Support from departmental colleagues	7
School/district-level systems and culture of support	7
Compensation	6
Teacher autonomy	6
Specialness of place	6
Resources for Teaching	6
Opportunity and Agency for Professional Growth	3
District and school-level race-consciousness	3
Affordances related to school size	3
Personal Satisfaction and Rewards	2

Support from Departmental Colleagues

Teachers explained that one of the biggest reasons they remained teaching in the same district, and often within the same school, was due to the collaborative nature of their science department. Teachers reported being welcomed by their colleagues in the department as novice teachers, which led to long-lasting friendships. When we asked them to describe what collaboration looked like, a frequent response was the willingness to share resources. For example, new teachers in Aspen and Pompano described being given unit plans, lessons, materials, and other resources.

In addition to sharing resources and materials, novice teachers received informal mentorship from the individuals within their department. Many teachers we spoke with explained that although they were assigned a school or district mentor, it was their department colleagues who provided the most meaningful support. In some cases, the close ties teachers developed arose out of shared district challenges, as was the case in Granite County Technical School and Sandstone School District, or because their coworkers were their family members and neighbors for generations, like in the Kingfisher School District. One teacher described the reason their colleagues were so important to their decision to stay by saying, "I mean I don't feel like I'm in my classroom alone, sometimes teaching can be an isolating kind of endeavor, but right next door, I know I can always knock" (Mulberry School District).

School/district-level systems and culture of support

A common feature of high-retention schools and districts in our study was the existence of a systemic culture of teacher support. This culture was evident in the ways that organizations made it possible for new teachers to receive support through the regular operation of the workplace. Teachers stated that their supervisors, administrators, and districts as a whole were very supportive and valued the teaching profession in both systemic and individualized ways. The district support system was reflected in the time, work, and monetary expenses invested in teachers to allow them to grow professionally, work in adequate conditions, and meet their professional needs. The school support system came from the school leaders, administrators and supervisors.

Compensation

Many districts in our study with favorable salaries also offered compensation for various roles. For instance, in Egret, Kingfisher, and Sandstone, mentors received stipends, resulting in better-structured mentoring and induction programs that helped retain teachers. In Linnet, teachers received stipends for giving up planning periods to assist elsewhere in the school. In other cases, teachers mentioned compensation for professional development and continuing education as a benefit. However, in two of our cases, teachers mentioned compensation as a tradeoff for meeting cultural needs or allocating funds to other resources, such as science classroom supplies. One teacher stated, "When I first got hired here, the pay was terrible, but when I looked at it compared to the resources we had, it was immeasurable. That was very important to me."

Teacher Autonomy and Agency

One of the first components of teacher autonomy we saw reflected in the responses from our participants was the freedom and flexibility given to teachers to teach how they want. Interviewed teachers at Birch, Egret, Pompano and Hickory stated how having "ownership in their curriculum" allowed them to teach how they wanted and be creative in the classroom by adding their "own personal style" of teaching, which was echoed by the ability to "own the curriculum."

> So, I am teaching an ecology class. I love being outside, I'm a big outdoorsman. So, we have a pond by our school, so I asked one of our principals if we could get a bunch of fishing poles and stuff. We just went fishing for like a week and a half. We collected some data on the fish and put it all together to try to determine if the pond was healthy or not. But after I planned on being done, the kids were like 'Can we just keep going fishing?' and I was like 'Sure let's spend another day fishing.'

Specialness of place

The concept of place-identity, drawn from environmental psychology, describes this factor. The physical environment and unique geographical place of the area were important in creating a sense of belonging and contributing to teachers' reasons for staying. The presence of family members, church connections, and a sense of familial duty were mentioned as reasons for teachers to remain in their hometowns and contribute to their communities. For some districts, the specialness of a place was tied to a location with a historical tie to cultural heritage. In the Kingfisher school district, teachers and administrators emphasized the importance of culture and Native American identity in creating a supportive and comfortable environment for teachers of color. Additionally, administrators claimed that teachers of color felt comfortable in Mulberry because of its distinctive culture and commitment to equitable and anti-racist education and uplifting of the Black community.

Resources for Teaching from the School and Community

For teachers we interviewed, adequate resources for teaching meant having the necessary science supplies to teach their students without having to reach into their own pockets. Some teachers expressed, for them, having access to classroom resources was more important than having the highest possible salary. Teachers often cited that access to adequate classroom supplies stemmed from having administrators who understood the unique needs of a science classroom, and therefore budgeted accordingly. For example, teachers discussed having materials to conduct higher level laboratory experiments in their classrooms, rather than being limited to items, like vinegar or baking soda, they would need to purchase themselves at the local grocery store.

Sometimes resources came in the form of partnerships with the community, such as local universities, as in the cases of Birch, Linnet, Kingfisher, and Rivuline. In the Linnet School District, parents who worked in the science industry or in university science labs often served as a source for providing laboratory materials that teachers may not have otherwise had access to. One of the science teachers at Linnet explained:

> We have a group of parents who, if we don't have equipment, I can always say — My first year there I said, "Oh I really wanted a skeleton but I forgot to order one." And I just sort of mentioned that to the kids like, "Oh, I would love to show this to you on a skeleton but I don't have one." And two days later a parent dropped off a skeleton like, "Oh I got it for you." "Cool, thank you." We've got parents that work in laboratories and we've had a lot of science equipment donated to us a bunch of years ago. We had about $200,000 worth of science equipment donated from a lab that shut down. So, we don't really want for anything as a science department.

However, parental support was not unique to Linnet school district, and was suggested by many science teachers we spoke with as a factor related to their retention, a factor we felt spoke to the community outside of the school.

Opportunity and agency for professional growth

For many teachers, having access to graduate courses, financial support for professional development opportunities, and the opportunity to attain advanced degrees influenced their decisions to stay. Multiple districts mentioned the support provided for teachers to pursue advanced degrees or graduate work, like in Birch's partnership with a university that offers teachers six graduate credits. Additionally, some districts offered opportunities for teachers to take on leadership roles and engage in professional development activities beyond their classrooms. In Kingfisher, teachers reported valuing the professional development with a local university and local Native American tribe quite highly. These districts made pointed efforts to encourage and empower teachers in order to expand their skills and expertise.

District and school-level race-consciousness

Here we define race-consciousness in education and by teachers as possessing an "awareness of race, of the possibility of their own racism and the racism of others, and the significance of these perceptions in the teaching and learning process" (Teel & Obidah, 2008, p. 4), as well as in the intentional district and school-level decision making. Two intentional practices we observed were in the hiring decisions of certain districts and the decisions around mentoring and induction. Examples included hiring graduates of the Noyce program (Birch charter school), hiring student teachers from the local community college (Hickory Island), and hiring both teachers and administrators of color (Egret and Mulberry). In Egret, with a large number of teachers of color on staff, novice teachers of color were mentored and coached by experienced teachers of color. In contrast, Hickory recognized the lack of diversity in their teaching staff as compared to their student population and therefore emphasized educating their teachers on race consciousness, such as helping teachers to understand the difference between equality and equity.

Affordances related to School Size

For smaller districts like Birch and Hickory, teachers felt they were a part of a "tight-knit family," which inherently made them "very close to a lot of coworkers." Teachers we spoke with explained that a small size school resulted in smaller class sizes, as well as receiving "personal support" from administration. Another affordance of working in a smaller school was the low student-to-teacher ratio. This was evidenced in our interviews with teachers in the Hickory Island school district, where the student-to-teacher ratio was below the state average, and particularly so in the advanced science courses. In contrast, districts like Chestnut and Rivuline benefitted from their large school district structure to retain their teachers due to their job mobility and having a large variety of colleagues. In large districts, teachers' mobility enabled interviewed teachers to remain in the district with the option to move to another school that they preferred. A science teacher mentioned, "That was probably the biggest difference when I came here. All of a sudden, I'm not the only physics teacher, and there's people that I can work with and share ideas with."

Personal Satisfaction and Rewards

The factor of teachers' personal satisfaction and reward from their job and profession played a big role for teachers in some of our cases and included examples like giving back to the community or teaching the students who were "interesting" and "invested". For teachers at Rivuline, this satisfaction came from teaching students in need. A teacher explained the connection between helping students in need and the personal satisfaction of working in a high-needs area. In districts like Sandstone, teachers mentioned their passion for teaching, and they call it a fulfilling vocation that they have been able to personally grow from. They also mentioned that there was a rewarding feeling when they are impacting someone's life. For interviewed Kingfisher teachers, there was a sense of reward for their career because the teachers' schedule provided them with time to raise a family and spend the holidays and weekends with their children.

Discussion

As described above, we came to this work looking for a more productive way to talk about teacher retention, and by doing so proposed the theory of teacher embeddedness as a more useful tool. Throughout our work, we used the TE framework to guide our thinking and as well as to refine our data collection tools and methods of analysis. After coding our data for key themes we saw across cases, we felt it a meaningful exercise to return to our theory of teacher embeddedness in order to organize our findings around the specific components of fit, links, and assets, in both the categories of organization and community. However, we want to emphasize that the designations we have used in the upcoming sections are not discrete from one another. What might be discussed as an example of link or fit, may or may not also fall into the category of assets and vice versa. However, we did our best to parse each of these findings out for explanatory purposes, as a way to make talking about the reasons teachers choose to stay more tangible and practical.

Fit: Organization

When looking for evidence of organizational fit for science teachers, we looked for ways in which science teachers felt they aligned to the values and culture of the school. For some, this meant that although their school did not provide them with the largest salary, they felt valued by having the necessary resources to support their students in their science classrooms, whether that meant top of the line laboratory equipment, or not needing to spend their own money on supplies. Though mentioned previously above in the section on compensation, however, here we highlight the importance of a shared philosophy around what it means to support teachers in teaching science well. For example, the teachers in Granite felt that their department of science teachers came to science teaching in a different way—primarily because of their previous careers in industry—and that this created a mindset that was different from other teachers who begin teaching directly from college. One Granite teacher put it this way:

> "It's just it's the I don't know just a different mentality, maybe a lot of us all, you know went to school in an environment where we were helped by our peers, and so I don't know I mean I, I worked in industry and we all work together, I mean it was you know again the collective department so. As a science department, we share with each other, now we, I mean I share with things across other departments, but I wouldn't say that that's necessarily the way the whole building works, I think sometimes people are a little bit more. . . So part of it is survival and just being smart about it, so if the teachers that are all teaching the exact same subject aren't on the same page, then you end up in a bad situation.

The evidence of a shared set of values or fit could be seen in some of our cases outside of the science department, and could be felt across the schools or districts. Teachers mentioned that their school districts provided opportunities for administrators to show and demonstrate their teacher appreciation through social events, where teachers were allowed to voice their concerns. Interviewed educators at Pompano and Mulberry stated that their retention had definitely been influenced by the district's personalized assistance with science pedagogy and consistent attention to their individualized needs.

Fit: Community

One example from our findings of such fit was the existence of a systemic culture of teacher support, which often included partnerships with local universities. These partnerships offered science teachers opportunities for science specific professional development as serving as physical extensions of the classroom laboratory space. By partnering with universities, science supervisors within the district made clear efforts to encourage and empower their science teachers to expand their skills as well as supplementing through university funding the necessary supplies science teachers need to successfully teach their content.

Another clear indicator of fit could be seen in our conversations with the science teachers we spoke to was their connections to the local community. Although this connection has been cited elsewhere in the broader literature on teacher retention, we highlight it here due to the specific ways the community impacted a science teachers' decision to not only stay, but to pursue the career in the first place. For example, in some of the districts we visited, science teachers felt strongly about living in a particular geographic location; the specialness of a particular place was either tied to cultural heritage or a commitment to equitable and anti-racist education. However, what appeared to be unique for these teachers was the limits they had in the possible careers they could pursue with their degrees in these particular towns, which were often places they had grown up. People with science-related degrees who wanted to remain in their hometown described feeling limited in their career choices to the fields of education or medicine.

The choice of science teaching was a way to use their degree in the place they wanted to live. In the case of Hickory, one retained teacher told us:

> Also, the community I mean I've been a part of this community for most of my life I was away, for you know six years or so. But coming back, I have a connection to the area, I think that also helps with having a connection with the students. I understand where they come from, even if they're from a completely different background than myself. I know what it's like to live here where it's crazy in the summer and you have to work, you work a bunch of jobs and then it's completely dead in the wintertime."

Links: Organization

When looking for evidence of links, we tried to identify ways in which individuals influenced a science teachers' decision to remain in the district. One example of links evidenced throughout our interviews with science teachers, both novice and retained, was the relationships formed with others in their department. Science teachers used words like "collaboration" or "comradery" to describe their relationships with their science department colleagues, and explained that these colleagues were willing to provide resources and materials, and even share a physical or digital folder with them that included everything they would need to teach their course. As former science teachers, we know that some science departments function as hierarchies, and resources and supplies are hoarded or kept confidential. In the districts where teachers were being retained, it was common practice to share materials and knowledge, rather than hoard them, and to support each other rather than to compete. In some schools this degree of comradery was supported by the science supervisor, if not initiated by them.

In addition to resources, science teachers referenced the informal mentorship they received from the other individuals within their science departments. Many explained that although they were assigned a school or district mentor, it was their department colleagues who provided the most meaningful support. From our interviews, we started to get a sense that perhaps, in districts with high levels of science teacher retention, it was the department as a collective who served as the mentor to novice science teachers, rather than a single individual.

Another example of links within the organization could be seen in the case of Hickory. Teachers attributed this closeness to the small size of the school, which afforded them opportunities to get to know students on more personal levels. Due to Hickory's small size, teachers are often involved with extra-curriculars and get the chance to know lots of different students in different contexts.

> I walk to school, so I walk to school and home, so I have conversations with the kids while I'm walking, I see them in my daily life outside of school, whether it be at the grocery store and we support each other, and you know if a family or a child in need the school comes together and helps those families on a regular basis. So, we are definitely a close knit community.

Similarly, teachers of color in Mulberry felt supported by the distinctive culture of the school district and community.

> "In districts where the students are predominantly African American, the top-level administration rarely reflects the population. In [Mulberry] it does, and I think that makes

> us unique…. How did that happen? I'm not sure, it's just always been that way since I've been here. It's one of the reasons that drew me to the district in the first place.

Links: Community

In several of our cases, it was the nearby connections that impacted teachers' reasons to stay. For example, some districts had relationships with nearby universities. In Birch, the teachers described this relationship as "synergistic," where student teachers from the university would come to the school for their clinical practice or internships, and teachers in return could use spaces in the university to teach their science courses. Additionally, the university offered opportunities for professional development and the ability to complete their master's degrees. Similar relationships with nearby universities were seen in the case of Kingfisher and Linnet.

Another example of community links could be seen in the case of Granite, where the sense of community extends beyond the student body and alumni, and into the nearby businesses. As a part of the technical nature of the school, students had the opportunity to work in their future field as high school students. In order to provide internships for students, GCTS developed relationships with many local businesses. This aspect of the school added an additional layer to the community feeling/relationships that may exist in other small districts. As one teacher noted, "Not only will you have students who are the children of students you have taught in the past, but you may also have students working in one of the local businesses that you frequent." It appeared that this extra layer of community attachment contributed to the close-knit feeling both teachers and administrators felt working at GCTS. One teacher explained this network in the local community as a "lineage."

Although the teacher retention literature speaks to the phenomenon of teachers returning to teach in their hometowns (Reininger, 2012), in Kingfisher County, there seemed to be additional influences at play. The character of the district's Native American culture was often invoked as a reason for the closeness experienced by their school community:

> Well, that has to do with who we are, our culture. First, foremost, who we are, what type of people we are. Most of the people around here, I don't know if you know it, but we're Native American, so that has a lot to do [with it].

Being from the area also meant that individuals in the school had particularly close ties with their fellow teachers and staff in the building. When someone in a Kingfisher school says their teaching community is like a family, it is not always metaphorical. Many teachers are in fact related to the people they work with. Others are friends and neighbors who have known each other, and each other's families, for generations. In Kingfisher County, teachers expressed the nature of the choice to teach locally in terms of a sense of responsibility to their community:

> I have nieces and nephews coming through, family members coming through, church members' children coming through. So, it's just, I don't want to say I feel obligated, but I almost feel like I need to stay here for all these kids. It's also rewarding because a lot of our kids go to our local university and graduate and then they work in our community.

This notion of teaching as a "familial duty" was more clearly stated by one of the novice teachers, who noted, "You want to take care of your parents, your siblings, you want to be a pillar in that sense, you have church connections."

Assets: Organization

When looking for assets within a district we looked for both tangible and intangible properties that influenced a science teachers' decision to stay. We heard throughout our interviews that salary was an important factor in a teacher's decision to stay in a district. Although this finding can be applied to teachers outside of the science disciplines, we find it pertinent to note that many science teachers hold degrees that could provide them with job opportunities outside of the field of teaching. Therefore, science teachers receiving adequate salaries may feel an additional sense of value for their expertise that science teachers in a lower paying salary may not feel. In other cases, however, teachers saw a lower salary as an adequate trade-off for having a well-resourced science classroom.

The theme of having adequate resources for teaching was present throughout much of our data. For most, this meant having the necessary supplies to conduct quality science lessons without having to reach into their own pockets. Teachers often cited that access to adequate classroom supplies stemmed from having administration who understood the unique needs of a science classroom, and therefore budgeted accordingly. For example, teachers discussed having materials to conduct higher level laboratory experiments in their classrooms, rather than being limited to items—such as vinegar or baking soda—that they would need to purchase themselves at the local grocery store. In addition to consumable classroom materials, having their own classrooms influenced their retention in their school or district.

In the case of Granite County Technical School, teachers described the physical work environment as an asset and reason for staying. One administrator explained:

> You know, first of all, you got to get, you know, your initial basic needs, have to be met, you know I'm looking in this nice office to the window and the sun's coming in. And it's a great place to be and I have a good support staff out there and I'm paid appropriately, you know so it's like okay. I'm happy with my compensation so I'm happy with the way I'm treated so, what can I do for you today.

Assets: Community

Community assets looked different depending on the district we were speaking to. For some teachers, it was the ability to live and work in the same town that afforded them with assets they attributed to retention. For a recently widowed, single mother working Chestnut School District, it was important for her to be working close to where her children would be attending school. She told us clearly, "I turned down other jobs that were further away. I chose the job that puts me closest to my children."

For others, the assets they derived from the local community were related to the lifestyle the community could afford you. For teachers working at Hickory Island, it was the proximity to the beach that they expressed kept that teaching in their district. One teacher expressed:

> I mean if I had to first and say I think has nothing to do with education, I think it has to do with the proximity to the beach. I mean we're two blocks three blocks from the beach so when you, you know when you grew up in an environment where you know you worked on the boardwalk you know at nighttime and you were at the beach all day. I mean who doesn't want that lifestyle right like that's number one.

In other places, many of those we interviewed expressed that being a science teacher in the local school district was a good paying and practical job, often better than other employment options, especially for someone with a science degree. In the case of Sandstone, administrators and teachers alike noted that the pay in Sandstone compared favorably to surrounding school districts, and pointed to their salary and other material benefits as a major reason for remaining in the district. “I don't really know how it compares to the larger cities like Philadelphia or Pittsburgh salary-wise,” said one experienced teacher, “but I do know compared to the local, smaller high schools around us, we do have it better financially.” The science teachers we interviewed also referenced their prospects outside of teaching as well. One teacher said, “I honestly have stayed [in Sandstone] because it's a good job and if I wanted to leave, I can't get …paid in industry, what I’m getting paid here.” Similarly, in Kingfisher, a number of teachers reported that they did not originally intend to enter teaching, but teaching was one of the few jobs available in the county for science majors. One of the retained teachers explained that local “job options are farming, retail, or teaching. [With] not a lot of job opportunities, teaching is a good option.” This was echoed by another retained teacher who said that the two biggest professional opportunities for individuals with a science degree in the area were in health fields and teaching.

Conclusion

Our study highlights the reasons science teachers stay as a function of the level of embeddedness they feel within both the organization of the school district and the broader community in which that district is located. We argue that by framing science teacher retention in this way, those charged with the responsibility for recruiting, hiring, and retaining science teachers can more clearly begin to develop strategies that will lead to increased levels of retention in their districts. In a study by Holtom and Interreiden (2006), using the framework of job embeddedness, individuals tended to leave a profession due to a particular “shock” or jarring event, rather than “accumulated levels of dissatisfaction” (p. 436). By using fit, links, and assets as guideposts for supporting their novice science teachers as they enter their schools and departments, our study suggests teachers' levels of embeddedness will help them withstand potential “shocks” and contribute to their decisions to stay.

Although our study highlights ways in which induction and mentoring were used to support new teachers, we also heard from many teachers that it was the informal mentorship they received that influenced their decision to stay. Even more specifically, in five of the districts we visited, teachers reported that it was the science department as a whole that provided this informal mentorship. One of the retained teachers in Granite County Technical School expressed that although, “you can reach out to anybody within the department and there's going to be this sense of helping each other and community and whatnot”, she felt it was the “organic” informal mentorship that impacted new teachers the most.

We conclude with some suggestions from our framework for those working to improve existing mentoring and induction programs or develop new ones, both for science teachers specifically and for all new teachers more broadly. First, it is worth asking what messages are being sent to newly hired teachers about what it means to be a member of the school, district and community. Working on finding ways to manage community fit seems a particularly underutilized approach in induction programs. It is also important to ask how induction and mentoring might be reshaped in order to strengthen links for novice teachers, both within the school and within the community. Recognizing the importance of informal mentorship, it is worth considering the ways in which employers might facilitate the creation and maintenance of links that might later become important, even to the point of creating and sustaining spaces where such links can be established and nurtured. Perhaps even more importantly, because this study calls into question the dominance of the one-to-one model of teacher mentoring for novice science teachers, we wonder how systems might be developed in order to support the broader notion of the science department as mentor model so common in the cases here.

References

Abell, S. K. (2007). Research on science teacher knowledge. In S. K. Abell & N. G. Lederman (Eds.), *Handbook of Research on Science Education* (pp. 1105-1150). Lawrence Erlbaum Associates.

Achinstein, B., & Barrett, A. (2004). (Re)Framing Classroom Contexts: How New Teachers and Mentors View Diverse Learners and Challenges of Practice. *Teachers College Record*, *v106*(n4), p716. http://dx.doi.org/10.1111/j.1467-9620.2004.00356.x

Bang, E., & Luft, J. (2014). Exploring the Written Dialogues of Two First-Year Secondary Science Teachers in an Online Mentoring Program [Article]. *Journal of Science Teacher Education*, *25*(1), 25-51. https://doi.org/10.1007/s10972-013-9362-z

Barth, P., Dillon, N., Hull, J., & Higgins, B. H. (2016). *Fixing the holes in the teacher pipeline*. http://www.centerforpubliceducation.org/Main-Menu/Staffingstudents/An-Overview-of-Teacher-Shortages-At-a-Glance/Overview-of-Teacher-Shortages-Full-Report-PDF.pdf

Bastian, K. C., & Marks, J. T. (2017). Connecting Teacher Preparation to Teacher Induction: Outcomes for Beginning Teachers in a University-Based Support Program in Low-Performing Schools. *American Educational Research Journal*, *54*(2), 360-394. https://doi.org/10.3102/0002831217690517

Bianchini, J. A., & Brenner, M. E. (2010). The role of induction in learning to teach toward equity: A study of beginning science and mathematics teachers. *Science Education*, *94*(1), 164-195. https://doi.org/10.1002/sce.20353

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

Boser, U. (2012). *Race to the Top: What Have We Learned from the States So Far?: A State-by-State Evaluation of Race to the Top Performance* Center for American Progress. https://cdn.americanprogress.org/wp-content/uploads/issues/2012/03/pdf/rtt_states.pdf

Boyd, D. J., Grossman, P., Lankford, H., Loeb, S., Michelli, N. M., & Wyckoff, J. (2006). Complex by Design: Investigating Pathways Into Teaching in New York City Schools. *Journal of Teacher Education*, *57*(2), 155-166. https://doi.org/10.1177/0022487105285943

Casely-Hayford, J., Björklund, C., Bergström, G., Lindqvist, P., & Kwak, L. (2022). What makes teachers stay? A cross-sectional exploration of the individual and contextual factors associated with teacher retention in Sweden. *Teaching and Teacher Education*, *113*, 103664. https://doi.org/https://doi.org/10.1016/j.tate.2022.103664

Ceven McNally, J. (2016). Learning from one's own teaching: New science teachers analyzing their practice through classroom observation cycles [Article]. *Journal of Research in Science Teaching*, *53*(3), 473-501. https://doi.org/10.1002/tea.21253

Darling-Hammond, L., Baratz-Snowden, J. C., & National Academy of Education (Eds.). (2005). *A good teacher in every classroom: Preparing the highly qualified teachers our children deserve* (1st ed.). Jossey-Bass. http://www.loc.gov/catdir/toc/ecip057/2005003695.html

Davis, E. A., Petish, D., & Smithey, J. (2006). Challenges new science teachers face. *Review of Educational Research*, *76*(4), 607-651.

Dawson, P. (2014). Beyond a Definition: Toward a Framework for Designing and Specifying Mentoring Models. *Educational Researcher*, *43*(3), 137-145. https://doi.org/10.3102/0013189X14528751

Feiman-Nemser, S. (2001). From preparation to practice: Designing a continuum to strengthen and sustain teaching. *Teachers College Record*, *103*(6), 1013-1055. https://www.tcrecord.org/content.asp?contentid=10824

Feiman-Nemser, S. (2012). *Teachers as learners*. Harvard Education Press.

Flores, S. M., Park, T. J., Viano, S. L., & Coca, V. M. (2017). State Policy and the Educational Outcomes of English Learner and Immigrant Students: Three Administrative Data Stories [Article]. *American Behavioral Scientist*, *61*(14), 1824-1844. https://doi.org/10.1177/0002764217744836

Fulbeck, E. S., & Richards, M. P. (2015). “The Impact of School---Based Financial Incentives on Teachers’ Strategic Moves: A Descriptive Analysis. *Teachers College Record*, *117*, 1-36.

Galosy, J. A., & Gillespie, N. M. (2013). Community, Inquiry, Leadership: Exploring Early Career Opportunities That Support STEM Teacher Growth and Sustainability [Article]. *Clearing House*, *86*(6), 207-215. https://doi.org/10.1080/00098655.2013.826485

Guarino, C. M., Santibanez, 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

Hattie, J., & Timperley, H. (2007). The Power of Feedback. *Review of Educational Research*, *77*(1), 81-112.

Holtom, B. C., Mitchell, T. R., & Lee, T. W. (2006). Increasing human and social capital by applying job embeddedness theory. *Organizational dynamics*, *35*(4), 316-331. https://doi.org/10.1016/j.orgdyn.2006.08.007

Holtom, B. C., Mitchell, T. R., Lee, T. W., & Eberly, M. B. (2008). 5 turnover and retention research: a glance at the past, a closer review of the present, and a venture into the future. *The Academy of Management Annals*, *2*(1), 231-274.

Howell, W. G., & Magazinnik, A. (2017). Presidential prescriptions for state policy: Obama's race to the top initiative. *Journal of Policy Analysis and Management*, *36*(3), 502-531.

Ingersoll, R. M. (1997). Teacher turnover and teacher quality: The recurring myth of teacher shortages. *Teachers College Record*, 41. http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=9712123482&site=ehost-live

Ingersoll, R. M. (2007). The Science and Mathematics Teacher Shortage: Fact and Myth. *NSTA Reports!*, *18*(9), 6-7.

Ingersoll, R. M. (2011). Do We Produce Enough Mathematics and Science Teachers? *Phi Delta Kappan*, *92*(6), 37-41. https://doi.org/10.1177/003172171109200608

Ingersoll, R. M., & May, H. (2011). The minority teacher shortage: Fact or Fable? *Phi Delta Kappan*, *93*(1), 62-65. https://doi.org/10.1177/003172171109300111

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

Ingersoll, R. M., Merrill, L., & May, H. (2016). Do Accountability Policies Push Teachers Out? Sanctions exacerbate the teacher turnover problem in low-performing schools--but giving teachers more classroom autonomy can help stem the flood [Article]. *Educational Leadership*, *73*(8), 44-49. https://repository.upenn.edu/gse_pubs/551

Ingersoll, R. M., & Perda, D. (2010). Is the Supply of Mathematics and Science Teachers Sufficient? *American Educational Research Journal*, *47*(3), 563-594. https://doi.org/10.3102/0002831210370711

Ingersoll, R. M., & Smith, T. M. (2003). The Wrong Solution to the Teacher Shortage [Article]. *Educational Leadership*, *60*(8), 30. http://www.ascd.org/publications/educational-leadership/may03/vol60/num08/The-Wrong-Solution-to-the-Teacher-Shortage.aspx

Ingersoll, R. M., & Strong, M. (2011). The Impact of Induction and Mentoring Programs for Beginning Teachers: A Critical Review of the Research. *Review of Educational Research*, *81*(2), 201-233. https://doi.org/10.3102/0034654311403323

Isenberg, E., Glazerman, S., Bleeker, M., Johnson, A., Lugo-Gil, J., Grider, M., Dolfin, S., & Britton, E. (2009). Impacts of Comprehensive Teacher Induction: Results from the Second Year of a Randomized Controlled Study. NCEE 2009-4072. *National Center for Education Evaluation and Regional Assistance*.

Kelly, P. (2006). What Is Teacher Learning? A Socio-Cultural Perspective. *Oxford Review of Education*, *32*(4), 505-519. http://www.jstor.org/stable/4618675

Kiazad, K., Holtom, B. C., Hom, P. W., & Newman, A. (2015). Job embeddedness: a multifoci theoretical extension [Report]. *Journal of Applied Psychology*, *100*(3). https://doi.org/10.1037/a0038919

Larkin, D. B., Carletta, L., Patzelt, S. P., & Ahmed, K. (2022). Making Sense of Science Teacher Retention: Teacher Embeddedness and its Implications for New Teacher Support. In T. T. York, L. Manier, & B. Calinger (Eds.), *Research in practice: Preparing and retaining K-12 STEM teachers in high-need school districts*. American Association for the Advancement of Science.

Larkin, D. B., Patzelt, S. P., Ahmed, K. M., Carletta, L., & Gaynor, C. R. (2022). Portraying secondary science teacher retention with the person-position framework: An analysis of a state cohort of first-year science teachers. *Journal of Research in Science Teaching*, *59*(7), 1235-1273. https://doi.org/https://doi.org/10.1002/tea.21757

Lee, E. (2006). Making Equity Explicit: A professional development model for new mentors. In B. Achinstein & S. Z. Athanases (Eds.), *Mentors in the making: developing new leaders for new teachers* (pp. 55-65). Teachers College Press.

Lee, T. W., Burch, T. C., & Mitchell, T. R. (2014). The story of why we stay: A review of job embeddedness. *Annu. Rev. Organ. Psychol. Organ. Behav.*, *1*(1), 199-216.

Luft, J. A., Firestone, J. B., Wong, S. S., Ortega, I., Adams, K., & Bang, E. (2011). Beginning secondary science teacher induction: A two-year mixed methods study [Article]. *Journal of Research in Science Teaching*, *48*(10), 1199-1224. https://doi.org/10.1002/tea.20444

Luft, J. A., Roehrig, G. H., & Patterson, N. C. (2003). Contrasting Landscapes: A Comparison of the Impact of Different Induction Programs on Beginning Secondary Science Teachers' Practices, Beliefs, and Experiences [Article]. *Journal of Research in Science Teaching*, *40*(1), 77-97. https://doi.org/10.1002/tea.10061

Mandel, Z. R., Fuller, E., & Pendola, A. (2018). *Production, Placement, and Retention of Secondary STEM Teachers of Color: A Case Study of Texas.* Paper presented at the Annual Meeting of the American Educational Research Association, New York, NY.

Marinell, W. H., & Coca, V. M. (2013). *Who stays and who leaves? Findings from a three part study of teacher turnover in NYC middle schools.* https://steinhardt.nyu.edu/scmsAdmin/media/users/sg158/PDFs/ttp_synthesis/TTPSynthesis_Report_March2013.pdf

McFarland, J., Hussar, B., Zhang, J., Wang, X., Wang, K., Hein, S., Diliberti, M., Forrest Cataldi, E., Bullock Mann, F., and Barmer, A. (2019). *The Condition of Education 2019*.

(NCES 2019-144). Washington, DC: U.S. Department of Education Retrieved from https://nces.ed.gov/pubs2019/2019144.pdf

McGinnis, J. R., Parker, C., & Graeber, A. O. (2004). A Cultural Perspective of the Induction of Five Reform-Minded Beginning Mathematics and Science Teachers [Article]. *Journal of Research in Science Teaching*, *41*(7), 720-747. https://doi.org/10.1002/tea.20022

Mitchell, T. R., Holtom, B. C., Lee, T. W., Sablynski, C. J., & Erez, M. (2001). Why People Stay: Using Job Embeddedness to Predict Voluntary Turnover. *Academy of Management Journal*, *44*(6), 1102-1121. https://doi.org/10.5465/3069391

Natriello, G., & Zumwalt, K. (2017). Pathways to a Profession [Article]. *Teachers College Record*, *119*(14), 145-147. https://www.tcrecord.org ID Number: 22218

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/https://doi.org/10.1016/j.tate.2020.103220

Ortega, I., Luft, J. A., & Wong, S. S. (2013). Learning to Teach Inquiry: A Beginning Science Teacher of English Language Learners [Article]. *School Science & Mathematics*, *113*(1), 29-40. https://doi.org/10.1111/j.1949-8594.2013.00174.x

Redding, C. (2022). Are Homegrown Teachers Who Graduate From Urban Districts More Racially Diverse, More Effective, and Less Likely to Exit Teaching? *American Educational Research Journal*, *59*(5), 939-974. https://doi.org/10.3102/00028312221078018

Reininger, M. (2012). Hometown Disadvantage? It Depends on Where You're From: Teachers' Location Preferences and the Implications for Staffing Schools [research-article]. *Educational Evaluation and Policy Analysis*, *34*(2), 127-145. https://doi.org/10.3102/0162373711420864

Roehrig, G. H., & Luft, J. A. (2006). Does One Size Fit All? The Induction Experience of Beginning Science Teachers from Different Teacher-Preparation Programs [Article]. *Journal of Research in Science Teaching*, *43*(9), 963-985. https://doi.org/ https://doi.org/10.1002/tea.20103

Saka, Y., Southerland, S., Kittleson, J., & Hutner, T. (2013). Understanding the Induction of a Science Teacher: The Interaction of Identity and Context [Article]. *Research in Science Education*, *43*(3), 1221-1244. https://doi.org/10.1007/s11165-012-9310-5

Saka, Y., Southerland, S. A., & Brooks, J. S. (2009). Becoming a member of a school community while working toward science education reform: Teacher induction from a cultural historical activity theory (CHAT) perspective [Case Study]. *Science Education*, *93*, 996-1025. https://doi.org/10.1002/sce.20342

Shore, L., & Stokes, L. (2006). The Exploratorium leadership program in science education: Inquiry into discipline-specific teacher induction. In *Mentors in the making* (pp. 96-108). Teachers College Press.

Sickel, A. J., & Friedrichsen, P. (2015). Beliefs, Practical Knowledge, and Context: A Longitudinal Study of a Beginning Biology Teacher's 5 E Unit [Article]. *School Science & Mathematics*, *115*(2), 75-87. https://doi.org/10.1111/ssm.12102

Simon, N. S., & Johnson, S. M. (2015). Teacher turnover in high-poverty schools: What we know and can do. *Teachers College Record*, *117*(3), 1-36. https://www.tcrecord.org/content.asp?contentid=17810

Soares, A., Lock, R., & Foster, J. (2008). Induction: the experiences of newly qualified science teachers [Article]. *Journal of Education for Teaching*, *34*(3), 191-206. https://doi.org/10.1080/02607470802213817

Spellings, M. (2007). *Final Guidance on Maintaining, Collecting, and Reporting Racial and Ethnic Data to the U.S. Department of Education* (72 Fed. Reg. 59267). Federal Register: U.S. Department of Education Retrieved from https://title2.ed.gov/Public/TA/Guidance.pdf

Stake, R. (2005). Qualitative case studies. In N. Denzin & Y. Lincoln (Eds.), *Handbook of qualitative research* (pp. 443-466). Sage.

Stake, R. E. (1995). *The art of case study research*. Sage Publications.

Stake, R. E. (2006). *Multiple case study analysis*. The Guilford Press. http://www.loc.gov/catdir/toc/ecip0514/2005017005.html
http://www.loc.gov/catdir/enhancements/fy0622/2005017005-b.html

Trygstad, P., & Banilower, E. (2015). *Leading from inside the classroom: Three cases of KSTF leading teachers (Report No. ER072016-01)*. http://kstf.org/wp-content/uploads/2016/01/Leading_from_Inside_the_Classroom_Three_Cases_of_KSTF_Leading_Teachers.pdf

Watson, J. M. (2018). Job Embeddedness May Hold the Key to the Retention of Novice Talent in Schools. *Educational Leadership and Administration: Teaching and Program Development*, *29*(1), 26-43.

Wood, M. B., Jilk, L. M., & Paine, L. W. (2012). Moving Beyond Sinking or Swimming: Reconceptualizing the Needs of Beginning Mathematics Teachers. *Teachers College Record*, *114*(8), 1-44. https://www.tcrecord.org/content.asp?contentid=16528

Zeichner, K. (2006). Studying teacher education programs: Enriching and enlarging the inquiry. In C. Conrad & R. C. Serlin (Eds.), *The Sage handbook for research in education: Engaging ideas and enriching inquiry* (pp. 79-93). Sage Publications.

Zeichner, K., & Liston, D. P. (1996). *Reflective teaching: An introduction*. L. Erlbaum Associates.

Zumwalt, K., Randi, J., Rutter, A. L., & Sawyer, R. (2017). First 11 Years: 25 Exemplar Alternate Route and College-Prepared K-12 Teachers [Article]. *Teachers College Record*, *119*(14), 42-55. https://www.tcrecord.org ID Number: 22221