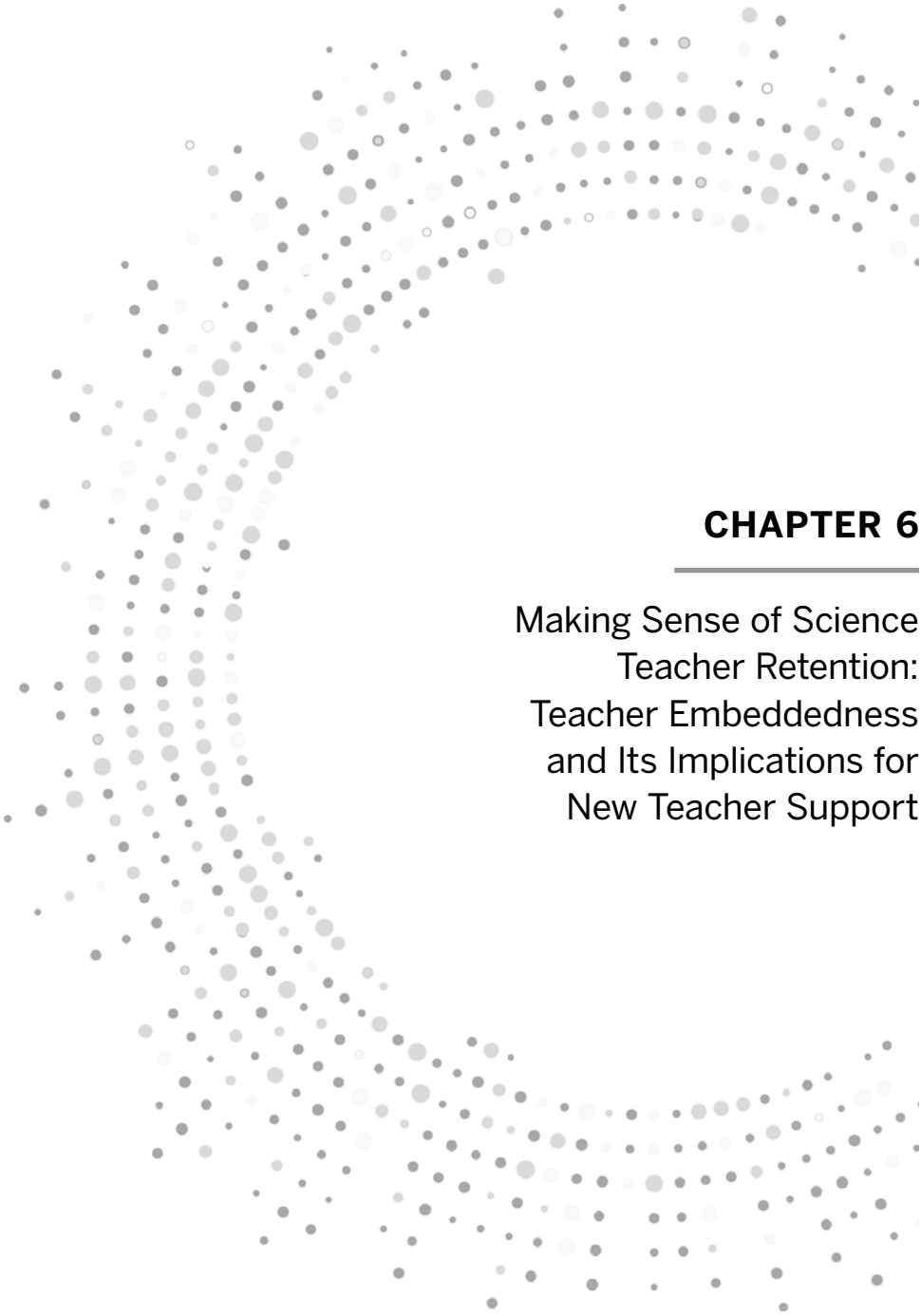

CHAPTER 6

Making Sense of Science Teacher Retention: Teacher Embeddedness and Its Implications for New Teacher Support

Making Sense of Science Teacher Retention: Teacher Embeddedness and Its Implications for New Teacher Support

Douglas B. Larkin, Liz Carletta, Suzanne Poole Patzelt, and Khadija Ahmed
Montclair State University
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> *By learning what factors help create the organizational and community contexts that permit a novice science teacher to remain and grow as a teacher, we hope to strengthen science teaching on a wider scale and to diminish the flow of well-qualified individuals out of the profession.*

ABSTRACT

This chapter reports initial findings from IMPREST, a 5-year research project that aims to investigate novice science teacher retention in the United States, with a focus on the underlying factors influencing retention for the teachers who stay. The goal of this project is to describe efforts to support novice science teachers across a wide range of school and community environments in places where the retention rate of novice science teachers is demonstrably well above average. In such districts, there are stakeholders who know and have learned a great deal about how to support novice science teachers and create conditions for their success, including district administrators, science supervisors, teachers, and community members, and a core aim of this project is to spread their hard-won practical wisdom to a wider audience. In this chapter, we report the design of the project, introduce the theory of *teacher embeddedness* used in this research, and share preliminary findings from case studies in six school districts.

This study found that retained teachers placed a high value on collaborative environments, adequate resources and salary, and the relationships they developed both within the school organization and the community. In many of the case study districts, the collective mentoring efforts of the science department as a whole was viewed by teachers as more important for retention than individually assigned mentors. In these districts, the human resources process of "onboarding" into the job was distinct from induction efforts to provide longitudinal new teacher supports. One clear implication from this study is the value of adequate common planning time, shared spaces, and engagement in informal relationship-building efforts because doing so helps teachers develop the links necessary to sustain themselves professionally over time.

Introduction

This chapter reports initial findings from a 5-year Noyce Track 4 research project at Montclair State University in New Jersey. The Induction and Mentoring Programs for the Retention of Science Teachers (IMPREST) project aims to investigate factors influencing novice science teacher retention in the United States. The goal of our research is to describe what is being done to support novice science teachers across a wide range of school and community environments in places where the retention rate of novice science teachers is demonstrably well above average.

In this chapter, we will describe how we adapted the framework of "job embeddedness" from the field of career research to create a conceptual framework of "teacher embeddedness" specifically for teacher retention. We have used this framework to make sense of novice science teacher retention in our study as well as of some of our preliminary findings.

The research reported in this chapter relied on two distinct definitions of "novice." The first, and narrower, definition is that of a first-year teacher who is in their first full-time position as a teacher of record. In our analysis of state staffing data, this is the definition we used because it allowed us to track individual teachers over time and identify the districts that were successful in retaining them. We used the second, more expansive, definition when we conducted interviews with teachers in these districts because we wanted to hear from first-, second-, and third-year teachers about the factors they considered in their decisions to remain or not remain in the district.

In the tradition of qualitative education researchers like Sara Lawrence-Lightfoot (1983), Gloria Ladson-Billings (2005), and John Goodlad (2004), we see the value in researching what is good and what is working in science teacher retention, as opposed to a pathological approach that seeks to diagnose what is wrong. Much of the existing body of research on teachers' careers frames the issue of retention in terms of attrition, with attention to investigating the reasons why teachers leave the classroom (e.g., Borman & Dowling, 2008; Guarino et al., 2006; Ingersoll & May, 2012; Ingersoll & Perda, 2010; Ingersoll & Strong, 2011; Rinke, 2014; Saka et al., 2013; Santoro, 2011). This work has been valuable in helping to identify variables that contribute to teacher attrition such as poor administrative support, lack of autonomy, contradictions between theory and practice, demanding teaching schedules, and difficulties with classroom management and student discipline. Our study flips this framing of teacher attrition and asks instead: Why do teachers stay? We argue that the answer to this question is not simply a matter of minimizing the factors above that contribute to teacher attrition, though such efforts remain important.

In districts with a track record for retaining novice science teachers, there are stakeholders who know and have learned a great deal about how to support novice science teachers and create conditions for their success.[1] This group includes district administrators, science supervisors, and teachers, and a core aim of this project is to disseminate their hard-won practical wisdom to a wider audience.

Over the past decade there has been a fundamental reconceptualization of the shortage of science teachers in U.S. schools. For a long time, the problem was considered to be one of recruitment. However, a sustained program of research begun primarily by Richard Ingersoll's detailed investigation of multiple decades of data from the School and Staffing

[1] In this chapter, we use the term "district" or "school district" as a shorthand reference to the more awkward but accurate term "local education agency," or LEA. In some cases, such as in the technical and charter schools described in this chapter, the LEA comprises a single school building.

Survey has led to the finding that the labor shortage 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). In other words, science teacher shortages can be addressed by improving science teacher retention.

Even when school districts hire science teachers carefully, it is difficult to predict whether a given teacher will remain. Certainly, as the work of a teacher unfolds over their time in a district, a teacher may accrue a mental tally of reasons to leave and reasons to stay. Even school districts that do well in supporting teachers may falter when it comes to their novice science teachers, precisely because of their specialized needs in both the subject matter and pedagogy of secondary science teaching. Teaching is challenging in many ways, and not every science teacher will be able to meet the demands of the job. However, it may also be the case that a promising novice science teacher is hired into a district that fails to provide appropriate support. In this situation, the teacher is less likely to be retained in that initial position and may choose to leave the position or even choose to leave the profession. In the worst case, the district continues to repeat the pattern without ever coming to know what is necessary to support novice science teachers. The present study is motivated by the need to interrupt such a cycle. Conversely, within the districts we examine in our study, something is going right. To this end, our project aims to learn from districts that are successfully retaining novice science teachers, and to make sense of teacher retention in ways that enable other districts to learn from these efforts.

Teacher Retention

The definition of "retention" varies across colloquial and academic usage, and in this chapter, we distinguish between two types of teacher retention in reporting our study's findings. To the school or district that hires a science teacher whom they wish to keep, the intention is that the teacher becomes an effective, reliable employee who does not have to be replaced for a long time. Such a teacher is defined here as *retained-in-position* because they are working for the same employer in the same position across two different points of time.[2]

From the perspective of a given teacher, simply remaining in a position may not comprise the whole of retention. A chemistry teacher who moves from one district to another, or to a different position either within or outside their district, perceives a continuity in their own work as an educator that their employers may not. Therefore, we also apply the descriptor *retained-in-profession* to those who transfer to other districts, teachers who are taking a break in service but intend to return to teaching, and those who remain in the field of education by building on their experiences as classroom teachers (e.g., school counselor, museum educator, positions in higher education, etc.). This distinction is necessary because from the perspective of the field, those individuals who leave employment as a P–12 teacher for work in education-related positions are engaging in work that is not only positive but necessary for the field of teaching (Cochran-Smith, 2004; Nieto, 2003). From the perspective of teachers, it simply does not seem correct to say that such individuals have left teaching, or ought to be counted as teacher attrition. Given that our unit of study is the individual school district, retention as discussed in this chapter refers solely to retention-in-position.

[2] A more fine-grained analysis (e.g., Boyd et al., 2011; Larkin et al., 2022) might distinguish between retention-in-position and retention-in-district, in order to examine the movement of teachers across schools within a district. We do not make such a distinction in the present chapter.

A number of studies have taken up the task of analyzing the effectiveness of various retention factors, such as salary (Bang et al., 2007; Borman & Dowling, 2008; Geiger & Pivovarova, 2018), administrative support (Boyd et al., 2011; Geiger & Pivovarova, 2018; Greenlee & Brown, 2009), mentor support (Geiger & Pivovarova, 2018; Ingersoll & Kralik, 2004), student demographics (Geiger & Pivovarova, 2018; Greenlee & Brown, 2009), and working conditions/school characteristics (Achinstein et al., 2010; Bang et al., 2007; Geiger & Pivovarova, 2018). Papay et al. (2017) noted that with the tentative exception of the existence of collective bargaining (see also Goldhaber et al., 2016), there was little evidence of strong relationships between teacher retention and observable characteristics. Yet throughout this large body of research, there has been little clarity in identifying specific contextual factors that could be used to predict teacher retention.

Certainly, there are factors outside of the direct control of individual teachers that determine whether staying in a particular position or even in the profession is possible. Such reasons may include reductions in force, family obligations, unsatisfactory teaching evaluations, certification issues, and personal health. What these factors have in common is that they are larger than the individual and that, in their absence, the teachers in this category would likely intend to continue employment as a teacher either in the position or in the profession. Such factors are beyond the issues of retention discussed here, though certainly some—particularly those related to teacher performance—may be heavily influenced by teaching context and available supports.

However, for the vast majority of teachers, the decision of whether to remain in a teaching position falls on them personally, and such *voluntary* decisions (Swider et al., 2011) are not easily categorized. Such decisions are complex and may not be related to job satisfaction. For example, sometimes a teacher leaves a position when they would prefer to stay, such as when a partner's job requires relocation. Other times, teachers stay in a position when they would prefer to leave, such as when the risk

of lost income or benefits is too high. Teaching itself can be considered an exploratory career (Rinke, 2014), and teachers may simply be ready to move on to another phase of their careers.

Methodology

Our study focuses on school districts in the United States that have above-average novice science teacher retention and seeks to learn how such districts support their new teachers. This study has two distinct phases, and in this chapter we focus primarily on the second phase. However, a brief description of the first phase is provided to explain the state-level data analysis, which is how the sites for the second phase were identified.

First Phase: State-Level Data Analysis and Site Selection

In the first phase, we used publicly available staffing data from 2007 to 2018 to construct a 5-year retention map for six cohorts of novice science teachers in each of four U.S. states (New Jersey, North Carolina, Pennsylvania, and Wisconsin). This approach permitted our team to map the career trajectories of each individual science teacher for a more comprehensive picture of teacher retention, mobility, and attrition. For example, in sample-based studies, the departure of a teacher at the end of 1 year might simply be categorized as attrition. In viewing a 6-year trajectory, we were better able to identify teachers who left a position in a given year not simply as attrited, but possibly as having transferred to a different district or taken time off and then returned. While these teachers were categorized as retained-in-profession, they were not retained within the district, and we did not count them as retained-in-position for the purposes of this study (Larkin et al., 2022).

After analyzing individual teachers' career trajectories, we calculated the 5-year retention rate of newly hired science teachers in each of six cohorts for the years 2007–2012 for each school district.[3] We then created an indicator to assess the retention rates of science teachers over the first 5 years in order to make cross-district comparisons. This retention rate indicator was calculated as the sum of the total number of years each novice science teacher taught in the district divided by the total possible years. For example, if a district hired three novice science teachers during our period of interest, and Teacher A taught for 1 year, Teacher B taught for 3 years, and Teacher C taught for 5 years, that would sum to a total of 9 person-years. When divided by the total possible of 15 person-years (5 person-years possible for each of the three teachers), the district would have a new science teacher retention rate of 9/15 or 60%. Only one of those teachers, however, Teacher C, would be counted as retained under our 5-year retention criterion. Both the retention rate indicator (in person-years) and total number of 5-year retained teachers (as a ratio of total novice science teachers hired) were used to identify districts for the subsequent phase of the study.

Five districts per state were identified for a more detailed case study on the factors influencing science teacher retention. Districts were sorted initially for higher-than-average rates of retention, as described above, and focus districts were selected from those in the top 10% of retained novice science teachers in each state. We then attempted to diversify our selection of districts by looking at factors such as school size, location within each state, type of community (urban, rural, suburban) and relative wealth of the district. We also looked for districts that had hired (and retained) a significant number of teachers of color, as well as those that had hired graduates who had benefited from the NSF Noyce Teacher Scholarship Program. In each state we included one or two districts that

[3] For example, the 2007–2008 cohort was examined through the 2011–2012 school year, while the 2011–2012 cohort was examined through the 2017–2018 school year.

did not meet the National Science Foundation's definition of a high-need school, particularly if they retained teachers of color or Noyce graduates.[4]

At the time of this writing, data collection and analysis are still ongoing for the IMPREST project, yet we have completed enough case studies to illustrate the value of our teacher embeddedness theoretical framework and share some of the lessons learned so far about teacher retention in these districts. Information about the districts in this chapter is shown in **TABLE 1**, though because names and exact figures would permit district identification, values in the table are presented as approximations to maintain confidentiality, and district names are pseudonyms.[5] Names of individuals and position titles are similarly obscured in order to preserve internal confidentiality. **TABLE 2** shows further information about the relative size of the high school science faculty, retention rate, and the number of participants we interviewed in each district. The full district cases themselves may be found on our project website.[6]

Second Phase: Data Sources and Analysis Procedure

The research team invited each of the selected districts to participate in the study, and upon securing district approval, made arrangements to interview administrators, novice science teachers, mentor science teachers, retained science teachers, and anyone else involved in supporting novice science teachers. Early data collection was conducted

[4] 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 districts labeled as "high-need" LEA in Table 1 were identified as such by the percentage of students receiving free or reduced lunch in 2017-18.

[5] Pseudonyms were carefully selected at the start of the study in an effort to maintain project organization and communication of findings. New Jersey names are trees (Aspen, Birch, Chestnut, Hickory, etc.), Pennsylvania names are rocks (Granite, Sandstone, etc.), Wisconsin names are fish (Wallago, Tetra, etc.), and North Carolina names are birds (Egret, Kingfisher, etc.). No two cases begin with the same letter.

[6] *www.montclair.edu/IMPREST*

through in-person site visits to individual districts; after March 2020 all data collection was conducted through remote interviews via Zoom in order to maintain health and safety during the pandemic. The goal of the interviews was to collect data that would help our team better understand the factors that may have influenced teacher retention during the focus period of the data (2007–2018) and also to investigate current practices around the mentoring and induction of new science teachers. Details on the number and type of interviews conducted at each site are shown in **TABLE 2**. Other data collected included publicly available district performance reports as well as any documents provided by the district related to the mentoring and induction programs.

At the conclusion of data collection from each site, all interviews were transcribed and then coded using NVIVO12 software. Tentative themes were generated by the research team, though these themes were modified, discarded, or supplanted by emerging themes arising from multiple passes of the data. The one *a priori* theme that was included in every analysis was that of induction and mentoring, given the importance of characterizing induction and mentoring efforts in the district regardless of their roles as factors in retention. For the first case of Aspen, all four researchers coded data independently before meeting to identify emerging themes related to the issues of interest to the case. All four members of the research team then collaborated on constructing the narrative of the instrumental case (Stake, 1995). Subsequently, each team member then took the lead on the analysis and writing of each case, with the other team members providing critical feedback. Upon completion, the written case was then shared as a member-check (Lincoln & Guba, 1985) with each person who had been interviewed in that district, along with an electronic form in which feedback could be provided anonymously. Any feedback from this member-check process was incorporated into the final version, which was then posted on the project website.

TABLE 1

Descriptions of Districts Discussed in This Chapter

District	Description	Total student enrollment in 2017–2018	Percent of students receiving free/reduced-price lunch in 2017–2018	Percent of students identified as limited English proficiency in 2017–2018
Aspen School District	Regional Secondary school district with one high school. Non-high-need LEA.	3,000	10%	2%
Birch Charter School	Urban charter school affiliated with a local university. High-need LEA.	500	75%	0%
Chestnut School District	Large suburban district with two high schools. Non-high-need LEA.	11,000	20%	3%
Hickory Island School District	Small district with one high school; seasonal population. High-need LEA.	1,000	70%	20%
Mulberry School District	Urban school district with three high schools and success in retaining teachers of color. High-need LEA.	9,000	60%	5%
Granite County Technical School	Regional vocational school with an academic program. Non-high-need LEA.	1,500	40%	2%

TABLE 2

Department Size, Retention Rate, and Participants Interviewed

District	Number of district science teachers grades 9-12 (2017–2018)	Retention rate indicator for novice science teachers	Total number of teacher and administrator interviews	Number of novice science teacher (exp < three years) interviews conducted[7]
Aspen School District	30	82%	16	3
Birch Charter School	3	85%	6	2
Chestnut School District	43	83%	34	0
Hickory Island School District	5	100%	5	1
Mulberry School District	30	65%	11	2
Granite County Technical School	13	100%	7	0

[7] Granite has had no science teacher vacancies since 2017, so there were no novice teachers to interview. In Chestnut, we interviewed six teachers who had been novices between 2007 and 2018, but no current novice science teachers elected to participate in this study.

Theoretical Framework

The Limitations of the Turnover Model of Retention

The turnover model of retention has a long history in organizational theory, and consists of two primary constructs: job alternatives and job satisfaction (March & Simon, 1958; Mobley, 1977). Turnover theory predicts that if someone is not satisfied with their job, and has somewhere else acceptable to go, they are more likely to leave, and "given the same level of dissatisfaction, people with more alternatives will be more likely to leave than those with fewer alternatives" (Holtom et al., 2006, p. 318). In this model, job alternatives reflect both the state of the labor market and an individual's personal capacity to change jobs.

Job satisfaction is a loosely defined term that captures whether someone finds the material, intellectual, social, and emotional conditions of their job acceptable in part or in whole (Lee et al., 2014). By this theory, if someone is satisfied in their position and the profession, they will likely choose to remain in the job. If someone is not satisfied but has few alternatives (or is unable to leave their job for any reason), they may also remain. In this model, if a teacher has the opportunity to take another position that promises greater satisfaction, the probability they will do so is increased.

In using the lens of job satisfaction to analyze voluntary turnover in a variety of professions, Holtom and Inderrieden (2006) found that more than half of the individuals in the study left due to a particular shock within the organization, not "accumulated job dissatisfaction" (p. 436). According to Lee et al. (1999) a shock is defined as "a particular, jarring event that initiates the psychological analyses involved in quitting a job" (p. 55). In general, shocks such as being assigned a new supervisor who is difficult to get along with or reckoning with the switch to a virtual workspace during a global pandemic are not unique to the field of education. However, some might argue that teachers experience shocks

that other professions do not tend to encounter. For novice secondary science teachers, a common shock is being assigned to teach outside of their discipline or certification (Luft et al., 2020).[8]

The model of job satisfaction is consistent with market-based theories of labor supply and demand, yet has been shown to have limited predictive power when applied to actual cases of job retention and voluntary turnover (Mitchell et al., 2001). Reducing attrition to job dissatisfaction fails to capture why some people can withstand either an accumulation of bad circumstances or shock and others cannot. It also neglects factors that may be extra-organizational, such as those related to the community and a person's own personal circumstances.

Toward a Theory of Teacher Embeddedness

We believe that the theory of job embeddedness, adapted specifically for the field of teaching and termed *teacher embeddedness* here, offers new insights on meaningful supports for novice teachers and is consistent with our aim to focus on why teachers stay, rather than why they leave (Lee et al., 2014).

The theory of job embeddedness originated in the fields of economics and applied psychology in order to serve as a better predictor of voluntary employee turnover than theories invoking job satisfaction and job alternatives (Holtom et al., 2006; Kiazad et al., 2015; Mitchell et al., 2001). Holtom et al. (2013) argued that job embeddedness grows over time as an individual makes more connections to both job and place, and therefore the longer a person remains at a job the more "stuck" they become, and the harder it is to leave. We note here that being stuck within an organization does not indicate whether such a state is desirable or undesirable on the part of either the individual or the organization.

[8] A study by Taylor et al. (2020) recently showed the pervasiveness of out-of-field teaching in U.S. middle schools, with 88% of all middle school science classes being taught by an out-of-field teacher.

In research on employee retention, the theory of job embeddedness has been used primarily for survey construction and subsequent quantitative analysis. Such job embeddedness surveys have been adapted for a broad variety of contexts and purposes, though in the existing literature its use tends toward prediction rather than as a guide to intervention (Mallol et al., 2007; Shah et al., 2020; Siedlok et al., 2015; Sun & Huang, 2020; Tröster et al., 2019). Even in the limited number of studies that examine novice teacher retention through the lens of job embeddedness, findings are typically presented in terms of a correlation between measures of job embeddedness and employee retention (e.g., Watson, 2018; Yildiz, 2018).

The main components of job embeddedness as originally described by Mitchell et al. (2001) are *fit, links,* and *sacrifice,* and are applied to two distinct domains: the organization and the community. 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. Additionally, in our adaptation of the job embeddedness framework to the context of teaching, we have reframed the construct of *sacrifice* into *assets*, which we discuss below. In our research, we seek evidence of fit, links, and assets in both the organization and community 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 (Hom et al., 2017). Simply put, new science teachers who may flourish in some environments might find it difficult to continue in others.

Links are formal and informal social connections and relationships. Within the workplace (organization), these links may be to colleagues and associated professionals. Within the local area (community), 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 all such links may also influence a person's decision not to leave their place of employment (Mitchell et al., 2001). Reininger (2012) found that most young teachers in the United States live in close proximity to their hometowns, and Engel and Cannata (2015) noted that this localism in markets for teacher labor tends to reinforce inequities in teacher quality.

The third component of the original job embeddedness framework, sacrifice, refers to "the perceived cost of material or psychological benefits that are forfeited by organizational departure" (Holtom et al., 2006, p. 320), as well as to the ease or difficulty of breaking the links described above. The notion of sacrifice is closely related to the psychological phenomenon of *loss aversion,* described by Kahneman and Tversky (1979) as the idea that "a salient characteristic of attitudes to changes in welfare is that losses loom larger than gains" (p. 279). The original job embeddedness framework suggests that sacrifices may include such things as leaving coworkers or a familiar office space, as well as the various other job perquisites (commonly referred to as "perks") that places of employment offer in order to sustain their workers without necessarily increasing their salary. Job perks may include retirement programs, health care benefits, and day care options. Leaving a position will entail losing assets that one values, and human psychology is such that these losses will be perceived as disproportionately larger than equivalent gains.

Within the original job embeddedness framework, the constructs of fit and links were defined in a positive sense with existing and identifiable indicators. However, the construct of sacrifice was defined as a conditional negative, with a close association to potential loss. Further complicating matters was the fact that such potential loss was often applied to aspects of the other two components, thus reducing the explanatory power of each construct. Within economics, assets are tangible and intangible things that have value, and being forced to give up assets is a reasonable

definition of sacrifice. Consequently, we use the term assets to describe those things which would be sacrificed if an educator voluntarily left a position. For our purposes, reframing sacrifice as a loss of assets allows for the positive identification of those assets.

TABLE 3

The Teacher Embeddedness Framework

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, workspace 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.

Note. Adapted from Mitchell et al. (2001) and Holtom et al. (2006)

Reframing job embeddedness as teacher embeddedness appropriates elements of this earlier theory and applies them to the unique circumstances and contexts of teachers in order to better understand the reasons for teacher retention. The components of teacher embeddedness are shown in **TABLE 3**. One primary difference in this aspect of the framework is in its specialization to the work of educators. Through the naming of the local education context, and the identification of specific examples (such as links to students), the teacher embeddedness framework presents a novel reframing of the job embeddedness framework with appropriate scope for research on teacher retention.

We agree with Lee et al. (2014) in seeing the immense value of a framework based on job embeddedness:

> *The overarching practical implication of job embeddedness is that contexts exist in which employees are more likely to stay. To the extent that organizations are able to influence those contexts, they will also influence individuals to stay within the organization (p. 212).*

We see the greatest promise in this approach in our work with the retention of novice science teachers. By learning what factors help create the organizational and community contexts that permit a novice science teacher to remain and grow as a teacher, we hope to strengthen science teaching on a wider scale and to diminish the flow of well-qualified individuals out of the profession.

Findings

In this section, we draw from our case studies to describe examples of teacher embeddedness in each of the six sites. The role of each of the three components of the teacher embeddedness framework—fit, links, and assets—is discussed in terms of both the organization and the community. Although we have arranged our findings into discrete sections in order to illustrate the role of each component of the framework, there is likely much overlap. Our intent with this section is not only to illustrate the utility of viewing retention through a teacher embeddedness lens, but also to provide examples of how the districts in our study supported new teachers, a topic that will be addressed further in the Discussion section that follows.

The Role of Fit in the Organization

Although teachers included in our study may not have used the term fit, it was evident that what they were describing could be categorized as feeling a sense of shared values and goals. Much of this organizational fit was expressed in terms of work with colleagues, the alignment of values, and teachers' self-efficacy in their work.

Though we discuss individual relationships in the next section, in many ways, fit was represented by the collective work of teachers and administrators, and by the science departments in particular. For many teachers in the six districts we visited, sharing similar values with their colleagues and administrators was cited as one of the reasons they remained at their schools. These values are not necessarily the same across districts, but the feeling of being on the same page was a common theme in teachers' reasons for choosing to stay. At Granite County Technical School (GCTS), teachers valued having personal freedom within their classroom while at the same time sharing a desire to collaborate with one another. One retained teacher expressed, "I feel like our departments are very collaborative; like we're very helpful with each other. People are willing to help each other out as far as pedagogy,

ordering equipment, sharing ideas, so I think that's why I've stayed so long." There was also some evidence that a shared view of teaching itself contributed to teachers' sense of fit. At GCTS, the shared vision included a greater emphasis on what one administrator described as "good teaching" and less emphasis on "teaching to the test."

The size of the school—and by extension the science department—was considered an important aspect of fit in both larger and smaller districts. In Birch Charter School, one of the novice teachers told us that because the school is small, the administrators were able to build community by creating opportunities for the staff and students to interact with one another. One of the Birch administrators echoed this idea: "I would say it's because we're like a family, we're so small. We're like a tight-knit family. Everybody knows everybody." Working in a small district afforded teachers not only a feeling of family, but also a feeling of having a greater impact on their students. One of the novice teachers working in Hickory Island School District explained that for him, the autonomy that comes with being the sole chemistry teacher, as well as clearly perceiving his direct impact on the students, "really makes working here and staying here not a hard choice."

A sentiment that was echoed in every school we studied with a significant number of students from low-income families was the value teachers placed on being able to help students in need. A retained teacher at Hickory Island told us that a lot of the teachers do "as much as they possibly can to help any of the students that need help in school." Being able to engage in such work was consistent with the values held by teachers in the school:

> *And, again it's not—because there's not any type of direction for us to do it—just most people that are hired, just naturally are doing that and so and that's another reason why I do enjoy it here, is because many of the people here are very much like-minded like myself.*

Another example of organizational fit that appeared for some of the teachers in our interviews was a sense of value alignment from having previously worked in nonteaching jobs within the science industry. Teachers explained that for the science teachers who share this work history, they felt they shared similar views on work ethic. One experienced science teacher at Granite County Technical School described it in this way:

> *I can't say that every other department in our school works the way we do. I think probably, whether it's the sense of several of us came out of industry . . . 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—and I share things across other departments—but I wouldn't say that that's necessarily the way the whole building works.*

In a number of the districts, careful consideration was given to fit during the hiring process. At Granite, ensuring that teachers "fit" within the climate and culture of the school was emphasized from the very beginning. One administrator explained that during the hiring process:

> *We kind of go through the routine of the interview, one, and then the best fit. I mean, because all of the people will apply with the same qualifications. They all have this and they all have the, you know, the experience or whatever. And then it's just about who seems the best fit for this school.*

In Aspen, where current teachers were included in the hiring process, careful consideration was given to how well a prospective teacher would fit with the existing department. One administrator noted, "It's nice when somebody has teaching experience for sure, but just because they have teaching experience does not mean they're necessarily a good teacher or that their teaching philosophies align with our district mission and our philosophies on pedagogy."

The Mulberry School District was able to recruit and retain novice science teachers of color at a higher rate than any other district in the study, and in describing the reasons why, one administrator discussed a recent panel hosted by the superintendent with Mulberry graduates currently in college. Students who were attending historically Black colleges and universities noted that these schools were "almost like a continuation of where they came from," while students who were attending predominantly White institutions had a more substantial adjustment to make. One teacher of color described her feeling of comfort in working in a district where the students looked like her:

> *I was kind of afraid to work in a district where there's more White kids because I feel like the parents are . . . [trails off]. Well, the thing is, I don't really have much experience with White people or other races, which is not really good at all.*

The implication was that the high rate of retention of teachers of color was influenced by a supportive school culture that did not present the types of barriers to teachers of color that might have existed in other districts.

One final finding worth mentioning with respect to fit concerns the ways in which new teachers started their jobs. The very first days of employment for a new teacher can be a whirlwind of information, with forms to be signed, keys to be issued, and policies to be reviewed. One of the commonalities of the districts we studied was that the human resources process of "onboarding" into the job was considered to be very different from well-designed district efforts to provide longitudinal new teacher supports.

The Role of Fit in the Community

For many of the teachers in our study, the school itself was important, but so was the community in which the school was located. In some cases, this was because it was the same school they attended as a student or was in the area where they grew up. Teachers cited wide-ranging reasons for their desire to work in a particular community with its students, and many were willing to travel longer distances in order to do so. Still others reported that they had felt little connection with the community at first, yet ultimately grew to see themselves as a part of the greater community in which they teach, which gave them a reason to stay.

Some districts, such as Hickory Island, made intentional efforts to bring new teachers into contact with the local community. More than one administrator reported providing tours of the district so new teachers could get a feel for the area and become familiar with the lives of the students they would be teaching. Other districts, like Birch, Granite, and Mulberry, hosted community night events and adult education opportunities that provided teachers with a chance to interact with the community beyond their colleagues and students. At Granite County Technical School, students have the opportunity to work in their future fields through internships, and teachers seemed to greatly value their relationships with local businesses.

The Role of Links Within the Organization

Organizational links were often cited both as reasons why individuals continued to teach in their districts and as reasons they came to teach there in the first place. As with other professions, teaching leads to close relationships with colleagues and supervisors, but it also can lead teachers to build links with their students, their students' families, and the local community. Current models of teacher induction also present opportunities for strong relationships to form between novice teachers and their mentors. Lastly, a distinctive opportunity for links in the field of education is the potential return of alumni students as teaching staff.

Throughout the case studies, teachers consistently mentioned that one of the reasons they remained at their schools was that they greatly valued their colleagues. One retained science teacher in Aspen High School stated, "The people that I work with in my department are a huge reason why I stay." A defining characteristic of the culture for Aspen students and teachers alike was high expectations. The science supervisor told us, "The science department here, it's a very strong group of teachers. They are devoted to their students. They hold each other and themselves to a very high standard."

At Granite County Technical School, a change in the school to include academic as well as vocational education led to a large number of teachers being hired in a single year. This created a cohort effect in which teachers found themselves relying on one another to overcome challenges related to the school's recent reorganization. One of the retained teachers explained that they were "all in the same boat," and strong bonds were created in overcoming the challenges together.

Sometimes science teachers felt connected to individuals both within and outside of their own department. One retained science teacher in the Chestnut School District described these connections:

> *It goes outside the science department, for sure. I'm closer with my science colleagues than, say, math or English, but the people that I work with every day . . . I think Chestnut Plains [High School] has a phenomenal staff. I would leave in a minute, because I know there are many other schools that have higher pay scales for the amount of years I've had, but I really like the people that I work with. I don't know that that would be the case in anyplace else that I would go. I have a lot of respect for my colleagues.*

For some of the teachers we interviewed, having the assurance that they would be working each day with colleagues they respected and enjoyed being around was more important than other job assets, such

as an increase in salary. Another teacher in Chestnut District said it well: "Better pay elsewhere might not mean better people. It may not mean being happier."

Teachers also spoke about the importance of supportive administrators, a point that has been raised in much of the retention literature (e.g., Boyd et al., 2011; Campoli, 2017; Grissom & Bartanen, 2019), and here we distinguish between the material support provided by the administrators (discussed as assets below) and the personal connections novice teachers made with those who supervise their work. For example, one administrator in the Chestnut School District described the way the science supervisor nurtured relationships with teachers as a form of "individualized support":

> *[Our] science supervisor in particular really, really pays attention to the teachers. He's watching them carefully, he is supporting where they need supports, he meets with new people frequently, just as check-ins, just to kind of get a finger on the pulse to see how everything's going and see what they need. And he runs that by me. He says, I met with so-and-so and this is what I'm thinking we need to do for her, or can we set her up with this? So that has been so critical, that individualized support, I think that is what. . . . And even for the people that . . . I mean I have to be honest, even for the people that are long-term subs, he's taking that level of care with them.*

It is important to note that the cultivation of a school and district environment where relationships are fostered, as described above, is itself a form of supporting the links for novice teachers.

In a similar manner, teacher induction programs have become commonplace in the field of education as a means to support novice teachers and promote retention. In many states, including New Jersey and Pennsylvania, a structured induction program is mandatory and

includes the matching of each new teacher with a more experienced teacher as their mentor. These mentor/mentee relationships may not always be sustained beyond the induction period, but when they are, it appears these relationships are a significant reason new teachers choose to stay.

In our study, the importance of mentor relationships came up several times. For example, one novice teacher at Birch Charter School described the influence of their mentor teacher and the link that was formed between them:

> *My decision started like three years ago, when I applied for the Noyce program and I started the teacher internship program. I started work here as a trainee and then I met my mentor and other teachers in the field. That relationship [with the mentor] helped me get a job and I owe her for that. . . . She's like my family and that's how close a mentor to me she is. So, I'm very lucky to have her. I mean, everybody here loves her.*

Another example of links that we identified through our analysis was that between teacher and student. Teachers consistently talked about the relationships they shared with their students and how important it was to remain in their school because of them. One of the experienced teachers at Hickory Island told us how building relationships with kids happened much more readily than building relationships with her colleagues:

> *I remember just loving the kids and loving the science and conveying that into my lesson, so that wasn't difficult at all, but I would say making interactions with other teachers and administration building those relationships were definitely difficult in the first years. . . . I'm not sorry that I built a relationship with the kids, because I still have those relationships. But looking back, if I would have made other administrative or faculty relationships it probably would have made things easier.*

At Chestnut School District a teacher also noted that "the students are definitely a motivating factor" to remain teaching there.

One important takeaway from the districts we studied was that mentoring was considered to be the responsibility of the whole science department, and not just of one assigned person. Even though new teachers were assigned individual mentors, in most cases, the school or district science department served a collaborative role in mentoring the new teacher, particularly in terms of content and curriculum. When other assets, such as resources, and autonomy, were taken into account, many retained science teachers expressed that it was not worth leaving their district for more competitive pay because they did not want to leave their science department colleagues.

The Role of Links in the Community

The teacher embeddedness framework suggests that the links individuals make in the community where they teach, beyond interactions with the colleagues and students with whom they regularly work, are an important component of their retention. In contrast with professional external links (such as those acquired through professional organizations, professional development, and continuing higher education), community links serve as a way for teachers to better understand the worlds of their students and provide conduits for information to flow in both directions.

Many opportunities for developing community links were facilitated by the districts we studied. For example, at Mulberry, the district held events where teachers and parents could get together to talk about science:

> *Here we have science night, STEM night, we have just meetings where parents learn about the content. It's a whole variety and I'm just talking about science, so even in the other content areas, we have all types of events where we involve our community.*

In a number of the districts we studied, new teachers were provided with opportunities to familiarize themselves with the communities in which the students lived. For example, in Hickory Island School District, the district tour for new teachers would end in the public housing area of town, where the principal would introduce teachers to parents.

At Granite, not only did teachers have students who were the children of students they taught in the past, but some also had students working in one of the local businesses that they frequent. As noted above, some of these relationships were leveraged to foster internship opportunities for students, and one teacher described this network created by the school in the local community as a "lineage." It appeared that this extra layer of community attachment contributed to the close-knit feeling both teachers and administrators had working for their school.

For those teachers who grew up in or near the district they are now employed in, relationships were also essential. One of the experienced teachers at Hickory Island explained it this way:

> *I've been a part of this community for most of my life. I was away for 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 a bunch of jobs and then it's completely dead in the wintertime.*

A similar sentiment was also made by one of Hickory's novice teachers:

> *The kids are, even kids that I don't have, they'll come talk to me. You're part of that group and that's kind of how Hickory is. A lot of the teachers around here went to school here and they went to school with the parents of the kids that are here, and there's a lot of kids that they're the second generation, third generation of people who went to Hickory High School,*

> *and the teacher that retired this past month with like 35 years, they saw multiple generations of Hickory people coming in and coming and going. So it's a great small-knit community and you get a lot of support from the town.*

In almost all of our cases, the current science teacher population included former students, and every school had administrators who highly valued their graduates who returned as teachers. Indeed, administrators indicated a strong preference on the part of schools to hire teachers who either had graduated from the district or who were otherwise local in some way. The empirical data that led to the selection of the sites seemed to bear out the notion that these high teacher retention districts hired such teachers, consistent with the findings of Reininger (2012). Though no districts we include in this chapter had an explicit "grow your own" program (Gist et al., 2019), many used informal links and networks to recruit teachers who had grown up in the district.

The Role of Assets in the Organization

Using the teacher embeddedness framework as a tool for understanding teacher retention allows us to look at those "things" teachers describe as influential in their decision to remain in their school or district and sometimes within the field as a whole. Throughout our analysis, there were several assets within the organization that seemed to cut across the cases, such as monetary assets (including adequate salary and classroom resources), as well as less tangible assets, such as teacher autonomy.

At Chestnut, salary appeared to be one of the driving forces for teacher retention. One teacher shared that although teachers were happy with many aspects of their district, "most of us would probably leave if we could be guaranteed our salary and security elsewhere." According to another teacher at Chestnut School District, "the salary scale is better than surrounding districts." At Granite County Technical School, teachers expressed that the salary was also a factor for remaining at their school. Because GCTS receives students from several sending districts in the

county, it pays teachers an amount close to the average salary of teachers in those sending districts.

For example, one of the novice science teachers at Granite explained to us that they felt their pay was fair, and the option to leave the district for a private school, where the salary would most likely decrease but the student population would be different, was unappealing. She also explained that she had no plans to leave to go to a district that pays more:

> *I personally live in a quote "wealthier" district and my mom has always been like, "Why don't you look there?" And I just say, "You know what? I don't want to have to deal with those politics and our pay is almost as good. I'd rather keep our platform that we have in this school than go to another school for just a little more money."*

For this teacher, a slight increase in salary would not offset the cost of what she might lose if she chose to leave GCTS. One of these assets was the existence of adequate materials for teaching; unlike many others in the teaching profession (Ingersoll & Collins, 2018), teachers at Granite County did not feel pressure to pay for materials out of their own pocket. "We get almost everything we want to order," one science teacher noted. The department chair, who is charged with ordering supplies, told us:

> *I've never disapproved of anyone, I never said, no we don't have money for this, or no, you can't have that. So, I mean, that's a nice perk. Like pretty much everything you want to try, you know, as long as you can prove that it's good for kids or it's going to help you, you know if you're teaching that, you can pretty much get it.*

Administrative support was cited by teachers as one of their reasons for retention in their districts. Such support often takes the form of providing adequate classroom supplies, particularly for science teachers, who typically need to order more supplies than do other teachers in the building. At Hickory Island, science teachers were allocated a higher

annual budget for supplies and materials than were teachers in other departments. According to an administrator there, "I give them a ton of money to say 'Spend it on labs'—where everybody else just gets $200 for materials, I give them close to $1,200: $200, for, you know, your pens, your markers, your notebooks, and then here's $1,000—spend it on materials, chemicals." Being provided with the materials they need, teachers felt valued and also inevitably experienced greater feelings of accomplishment during their classroom lessons.

Outside of monetary assets, teachers across all cases discussed how important it was for them to have ownership over what they did in their classrooms, and that it was a significant factor in their retention. In the retention literature, this is commonly referred to as teacher autonomy (Ingersoll et al., 2016). One of the retained teachers at Hickory Island School District explained, "I basically have control over my own classroom, so I can teach the science the way I want to teach you the science, and nobody tells me any different." Similarly, a retained teacher listed his reasons for staying at Granite County Technical School. He said, "I think it's a lot of the stuff that we spoke about—flexibility, freedom to teach the way that you want to teach." A retained teacher in Mulberry School District stated, "There's a healthy balance of the vision from up top, but also I still feel free enough to try new things in the classroom." An administrator at Birch Charter School noted that teachers in his school chose to stay because of the "ownership over the curriculum and the freedom to do what you want." Teacher autonomy, wherever it appeared in our case studies, was clearly a valued asset by retained teachers.

The Role of Assets in the Community

For many, the community in which their school was located afforded them several assets. One particular asset that came up repeatedly across cases was the value that many teachers placed on their commuting distance between home and school. For one teacher at Chestnut School District who was recently widowed, a short commute was more than just a luxury. She explained, "My children were growing up and I put them in a school near me. I turned down other jobs that were farther away. I chose the job that put me closest to my children." Other teachers at Chestnut felt the same way, telling us they stay because they live in the town, some as close as "five minutes from here."

For teachers at Hickory Island School District, living near their school meant they were in close proximity to the beach, which they valued highly. According to one teacher:

> *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 at nighttime and you were at the beach all day, I mean who doesn't want that lifestyle, right? Like that's number one.*

At other schools, some teachers chose to remain teaching in their community *despite* their commute. One of the school's most experienced science teachers stated, "I fell in love with Birch City when I started here. I love diversity." This particular teacher was willing to commute 80 miles from her home (in a much less diverse community) to Birch Charter School. She explained, "I don't mind doing it because I love what I'm doing. And I love the school and the area."

Discussion

Our purpose for looking at teacher retention through the lens of the theory of teacher embeddedness was to provide a deeper understanding of why science teachers remain in their positions. Not only does teacher embeddedness help describe why teachers stay, but this analysis reveals implications for the design of potential supports for teachers.

Our findings suggest that using educational resources to work on a teacher's sense of fit within the district is a worthwhile use of professional time in schools. For example, explicitly dealing with how individuals can enact their personal interests and goals within their work may involve discussing personal goals, thinking through career aspirations, and conducting value affirmations (Borman, 2017). Issues impacting fit, such as the presence or absence of racial microaggressions (Mawhinney & Rinke, 2019) and the accumulating effects of standardized testing and punitive teacher evaluation systems (Dunn, 2020), and other forms of erosion of teacher autonomy, need continued attention. While we did not hear about these particular issues from the teachers we interviewed, it is important to remember that we interviewed in districts where teachers were choosing to stay.

In schools, relationships are built through shared experiences and classrooms, through scheduled or opportunistic personal interactions, and in the context of the daily operations of the school in a myriad of ways. Like any relationship, links are nurtured and grow over time, and a key ingredient is the development of trust (Bryk & Schneider, 2002). Therefore, fostering the ability and capacity of teachers to establish new links and sustain existing ones becomes an important avenue for retention efforts. Novice teachers may be particularly vulnerable to the dissolution of links, and unless forms of interaction and communication are established that permit existing links to persist and new ones to flourish, it is reasonable to predict that this component of teacher embeddedness will be weakened. Novice secondary science teachers

in small schools—where they may be the only teacher for a particular subject—may have even fewer possibilities for subject-specific links for support within their own school.

Given the importance of links in teacher retention, the implication is that the ability to maintain social relationships is key and ought to be nurtured in new ways. For example, multiple teachers across the districts interviewed in this study referenced the use of common resources, such as lesson and unit plans located in a shared online folder, as one strategy for supporting new science teachers in their departments. An administrator would be well served to be aware of such a resource—even if they themselves do not access it—in order to encourage participation so that novice teachers continue to benefit from these collegial links.

As we discussed briefly in the section regarding fit, the science teachers we interviewed highly valued collaborating with each other. Overburdened teachers with little time to co-plan or collaborate with colleagues built into their day may be less likely to develop the links necessary to sustain themselves professionally. Facilitating the creation of new pathways for link formation both within the organization and in the community would seem to be a worthwhile component of the effort to retain teachers (Shirrell, 2021; Zavelevsky & Lishchinsky, 2020).

With regard to assets, certainly equitable funding for schools remains a critical issue, and the adequacy of resources for teaching ought not to be taken for granted (Baker, 2018). If teachers feel that they do not have adequate resources to do their jobs, their embeddedness is likely to be weakened. Recognizing that time is also a resource that can be reallocated is important as well.

Fit, links, and assets are all interlocking components for retained teachers and are found both within the organization of the school and district and in the wider community. This was exemplified by one Mulberry science teacher, who offered the following justification for his remaining in the district for so long:

First of all, there are a lot of opportunities for progress, for self-growth, that is important to me. They are again a very collaborative and supportive administrative team. That pay is also good relative to other comparable schools. I'm able to, at this point—initially, no—but at this point I'm able to use my skills to assist teachers. So that's actually one of the main reasons that the position is really appealing. The district is really appealing because I'm able to offer a lot of recommendations to supervisors and principals that are even outside of my school. So that kind of interaction and the intellectual stimulation is part of the reason that I have stayed here.

Limitations

We recognize several limitations on our study. First, the selection of the districts was intended to provide us with the very best examples of where teachers were being retained. However, in order to be selected, a district had to have hired—and retained—novice science teachers during the period of our study (2007–2018). In order to have hired a new science teacher, the districts had to have had an opening, either through attrition or through the addition of a new position. This means that districts that did not have an opening in this time period were not included for selection, although—or perhaps *because*—they may, in fact, have been doing the best at retaining their science teachers. Thinking another way, it is possible that the districts that did have openings, and were therefore selected (when they succeeded in retaining new hires) had issues related to retention that caused these openings. However, it is equally likely that the openings were caused by normal retirements or teachers leaving for reasons outside of the district's control (such as moving for a partner's job change or another reason, as mentioned previously).

One other limitation is that the interviews took place during the 2019–2020 and 2020–2021 school years. Many of the novice teachers we interviewed were not teaching in these districts during our study years, and even some of the administrators and retained teachers were not (yet) in these districts during the period of our study. However, there were some cases when the retained teachers in our interviews were, in fact, the novices retained during the period of study, and other retained teachers had been there since before such time. In addition to the individuals, the policies in place during our study years are not necessarily in place during our interviews. In focusing primarily on the issue of teacher retention, we ground our study in the assumption that if the districts were good at retaining novice teachers during the 2007–2018 time period, then they remain effective at doing so now, but we realize this may not always be the case. As is true with much case study work, our findings illuminate the particulars of the specific context while refining broader understandings of the phenomenon under study.

Interviews for three of the six cases mentioned in this chapter took place in the schools, before the closure of schools due to the COVID-19 pandemic. Interviews for the other three districts were conducted online during in-person school closures. Therefore, we did not always have the opportunity to get a feel for the school, and perhaps missed some important cues that would have been apparent had we visited in person. However, in some cases, online interviewing made scheduling interviews (and rescheduling, when necessary) easier on both the research team and the teachers. Still, teachers may have felt a certain level of screen fatigue (in addition to general pandemic weariness) after so much online teaching, especially since we interviewed them during or immediately following their teaching day.

Conclusion

The theory of teacher embeddedness holds great promise as a theoretical framework, and we suggest that it may have great utility beyond its use as a predictor of turnover and may even serve to guide the creation of mentoring and induction programs for teachers. We argue that new insights regarding a teacher's decision to stay in their current position may be elicited using this framework, as demonstrated here by using teacher embeddedness to analyze issues of teacher retention.

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