Urban Districts' Strategies for Responding to Mathematics Teacher Shortages

Edward Liu, Joseph G. Rosenstein
Aubrie E. Swan & Deena Khalil
Rutgers, The State University of New Jersey

Abstract: Urban schools and districts are having difficulty staffing their classrooms with high quality mathematics teachers. This article builds upon the authors' earlier work exploring the complex challenge of recruiting and retaining math teachers. It describes how administrators in eight urban districts in the northeastern United States are responding to the math staffing challenge and examines the mix of strategies that the districts are employing. Interviews with 43 district and school-based administrators reveal that they are pursuing a wide range of strategies that address various aspects of the challenge and utilize a variety of policy instruments. Administrators sometimes adopted different approaches to addressing the same aspect of the challenge, and this appeared to reflect differences in their views and assumptions about the nature of the problem. Moveover, administrators' strategies and reported success appeared to reflect an interaction between three factors: (1) the particular nature of the *challenge* facing their district, (2) the *constraints* (both real and perceived) that administrators faced, and (3) the organizational *capacity* that the districts and schools had or were able to build. The authors conclude that although providing incentives to increase the supply of candidates may be important, it is also important to focus on capacity building.

Research for this paper was supported by MetroMath: The Center for Mathematics in America's Cities, a Center for Learning and Teaching funded by the National Science Foundation under Grant #ESI0333753. Any opinions, finding, and conclusions or recommendations expressed in this paper are those of the authors, and do not necessarily reflect the views of the National Science Foundation. Please direct correspondence to Ed Liu at ed.liu@rutgers.edu or Joe Rosenstein at joer@dimacs.rutgers.edu.

INTRODUCTION

Recent research has confirmed what policymakers, educational administrators, and the public at large have long known: teachers have a major impact on student achievement (Nye, Konstantopoulos, & Hedges, 2004; Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004; Sanders & Rivers, 1996). Research has also documented large disparities between the qualifications of teachers in schools serving low-income students and students of color and those of teachers in schools serving high-income and white students (Lankford, Loeb, & Wyckoff, 2002; Peske & Haycock, 2006). Of particular concern to many policymakers and administrators is the challenge of staffing the nation's schools with qualified mathematics teachers—a group that is in short supply. Several national reports have pointed to the need to increase the pool of highly qualified mathematics teachers as a way to improve mathematics education and, thus, the United States' economic competitiveness (Glenn Commission, 2000; National Academy of Sciences, 2007). Recognition of these three facts—that teachers matter, that high quality teachers are unequally distributed among schools and students, and that there is a shortage of qualified mathematics teachers —has led to a renewed interest in how urban districts hire, support, and retain teachers.

The goal of this research study is to document and understand how central office and building administrators in eight urban districts in the northeastern United States are responding to the challenge of staffing their secondary schools with high quality mathematics teachers. In an earlier paper, we presented preliminary findings about the multifaceted nature of the staffing challenge in six of these districts (Liu, Rosenstein, Swan, & Khalil, 2008). The administrators we interviewed painted a picture in which supply is tight, demand is high, and competition with other districts for the best math candidates is fierce. Virtually all of them complained about the overall quantity and quality of the pool of secondary mathematics candidates from which they

had to choose. However, we also found three sets of factors that exacerbated the staffing challenge and that affected how administrators responded to it: policy factors, organizational factors, and a set of factors related to administrators' own views of teacher quality and the unique characteristics urban teachers needed in order to be successful. Together, these factors often: (1) restricted district flexibility; (2) made it difficult to hire early, when the pool was largest and of highest quality; (3) reduced districts' competitiveness in terms of hiring teachers; and (4) reduced the number of candidates who were viewed as acceptable (i.e., the effective supply). Thus, we found that the challenge of staffing urban secondary schools with high quality math teachers is complex and multifaceted.[1]

In this follow-up paper, we describe and analyze how the eight urban districts in our study are responding to this complex challenge. We examine the mix of strategies that districts and schools are employing to staff their mathematics classrooms. These strategies have helped them fill the vast majority of secondary mathematics positions with individuals who fit the "highly qualified teacher" provisions of *NCLB*, although to do so they have often had to make trade-offs and compromises in terms of the qualities that candidates hold. In our analysis, we also draw upon McDonnell and Elmore's (1987) framework for understanding the uses, assumptions, and underlying logic of four classes of policy instruments: mandates, inducements, capacity-building, and system-changing.

[1] The first paper was written based on an analysis of the first six districts that agreed to participate in the study. As we expanded our study from six to eight urban districts, we found that the administrators in the two additional districts had similar descriptions of the staffing challenge as those in the six initial districts. Indeed, the addition of the districts confirmed and strengthened our findings.

REVIEW OF LITERATURE

The Nature of the Staffing Challenge

Various explanations have been offered as to why school and districts are having difficulty recruiting and retaining quality teachers, and, in particular, quality teachers in mathematics and other high-need subject areas. Some analysts point to the level and structure of teacher pay as a major culprit (Ballou & Podgursky, 1997; Hanushek, 2001; Odden & Kelley, 1997). By rewarding teachers solely on the basis of educational level and years of teaching experience, the traditional single salary scale does not vary pay to reflect the relative supply and demand of teachers in various subjects. The inability of districts to offer competitive salaries to individuals with strong math backgrounds, who have many options in fields other than teaching, is viewed as a major problem. Thus, according to this perspective, insufficient pay and incentives are the cause of the inadequate supply.

Another supply-side perspective focuses on the teacher "pipeline" and observes that universities and colleges are producing insufficient numbers of individuals with strong enough mathematics backgrounds to teach math at the secondary level. Some policymakers and analysts in this camp argue for strengthening mathematics teacher education and providing incentives for math students to enter teaching (National Academy of Sciences, 2007). Others who focus on the pipeline, however, take a more deregulatory approach and promote the expansion of alternate routes to certification as a way to increase supply (Thomas B. Fordham Foundation, 1999).

In contrast, another group of researchers and observers has focused on demand-side factors. Ingersoll (2001) has demonstrated that high levels of teacher turnover play a major role in teacher shortages by increasing demand. This, he and others argue, is tied to organizational factors, since many of the reasons teachers leave schools or the teaching profession are related to

working conditions, principal leadership style, and lack of support—though salaries and compensation, of course, are also important (Ingersoll, 2001; Johnson & The Project on the Next Generation of Teachers, 2004; Smith & Ingersoll, 2004). Support and working conditions are particularly important, because teachers' career decisions are motivated by both extrinsic and intrinsic rewards (Johnson & Birkeland, 2003; Liu, Johnson, & Peske, 2004; Lortie, 1975), and their ability to obtain the latter are heavily influenced by the environment in their school and district. From this perspective, greater emphasis should be placed on retaining teachers by improving the support and working conditions in the districts that hire them.

Organizational issues also arise in the area of hiring and human resource systems. Some blame seniority-based transfer rights that are part of the collective bargaining system for hampering districts' ability to hire qualified teachers in shortage areas (Levin & Quinn, 2003). Others, such as Liu and Johnson (2006) and Neild, Useem, Travers, & Lesnick (2003), point to the ways in which districts organize hiring and the effect that hiring systems have on the matches between schools and candidates. Poor hiring systems may lead to mismatches, which later lead to dissatisfaction and turnover (Liu, 2005). Many analysts, including those above, point to dysfunctional personnel practices and late hiring as problems that hinder the recruiting and retaining of talent, and argue that improving hiring practices is a key to raising teacher quality.

Yet another perspective acknowledges that organizational conditions and practices in education are shaped both directly and indirectly by education policy. Thus, it is important to consider administrators' attempts to improve hiring practices within the context of a variety of federal, state, and district policies. Harris, Rutledge, Ingle, & Thompson (2006), for instance, find that principals' hiring decisions are often influenced by external policy constraints, especially those related to teacher certification and tenure. Understanding the role that the policy

context plays in districts' attempts to address the math teacher staffing challenge is therefore important.

The Unique Challenges Facing Urban Districts

Although many districts have difficulty recruiting and retaining quality teachers, urban districts face additional challenges. As Lankford et al (2002) note, based on their analysis of the teacher labor market in New York State, "From a policy perspective, urban schools confront an enormous challenge…. [They] systematically receive less qualified teachers than their suburban counterparts and many of the dynamics work to the disadvantage of urban students" (p. 55). First, teacher labor markets are quite local in nature, and shortages of high-quality teachers are most pressing in urban, low-income districts. Boyd, Lankford, Loeb, & Wyckoff (2005) have found that teachers seem to have a preference for teaching close to where they themselves grew up (or in similar locales). This, they argue, "challenges urban districts, which are net importers of teachers" (p. 127). Second, patterns of teacher migration also work against poor, urban schools and districts. In their transfer behavior, teachers tend to migrate away from teaching poor, low-performing, and "minority" children (Hanushek, Kain, & Rivkin, 2001; Lankford et al, 2002) and toward more affluent and homogeneous schools. Third, urban districts may not be as able as suburban schools to deliver the same combination of incentives, support, and working conditions that have been demonstrated to play an important role in teachers' career decisions (Ingersoll, 2001; Johnson, 1984; Liu et al, 2004; Lortie, 1975).

Earlier Findings on the Nature of the Math Staffing Challenge

In an earlier article (Liu, Rosenstein, Swan, & Khalil, 2008), we examined in great detail the nature of the challenge of recruiting and retaining math teachers experienced by urban

districts. We summarize these earlier findings to provide important context for understanding the analysis in this article.

I. The Surface View: Tight Supply, Strong Demand, Fierce Competition. The administrators interviewed in our study uniformly saw recruiting and retaining quality math teachers as a significant challenge. At the surface level, central office and building administrators collectively painted a picture in which supply was tight, demand was high, and competition for the most highly qualified math candidates very fierce.

Supply – A shortage of qualified candidates was almost always the first thing that administrators mentioned when asked about the factors that made finding and hiring math teachers a challenge. Their general explanation was that there were too few math majors to begin with, that few of the math majors were interested in teaching, and that even fewer wanted to teach in urban schools because of the perceived challenges associated with them. District administrators were lucky if they received three applicants for a secondary math opening.

The supply of potential math teachers was further limited by the frequently expressed perception that many otherwise "qualified" teachers did not have the additional qualities that they needed in order to be successful in urban classrooms. Administrators' list of desired characteristics and criteria was quite long and very difficult for any individual to meet. To start off, an ideal teacher candidate would be certified, have been prepared in a university-based teacher education program, already have teaching experience, and have classroom management skills, a deep understanding of math content, pedagogical content knowledge, and pedagogical skills such as the ability to promote active learning in classrooms as well as the ability to differentiate instruction. In addition, administrators appeared to have a set of extra characteristics or background factors that they saw as necessary for successful teaching in *urban* schools. These

included: a deep commitment to urban education; strong interpersonal skills, a liking of children and an ability to relate to them; an understanding of the lives of urban children gained through life or work experience; and various personal skills and dispositions, such as persistence, flexibility, and the willingness and strength to do one's job despite the hurdles and indifference presented by the district bureaucracy.

Demand – Although the small candidate pool seemed to be the first thing that came to administrators' minds, demand factors were also mentioned. The administrators were most likely to point to retirements, enrollment increases, family leaves, and dismissals (involuntary terminations) as the main factors driving their need to replace 13-23% of their math teachers each year. Although there is a perception that many teachers voluntarily leave urban schools for suburban schools, our interviewees were somewhat less likely to mention voluntary departures as a major driver of demand, though this certainly played a role. In some districts, demand was also driven by policy and organizational decisions, including early retirement incentives, decisions to intensify math instruction (which meant that more teachers would be needed), and the creation of instructional leadership roles that took some math teachers out of the classroom, who then had to be replaced.

Competition – Administrators also described fierce competition for math candidates, and saw this competition as limiting both the number of applicants they received as well as their ability to convince applicants to accept job offers. Principals and central office administrators frequently described losing their most highly qualified candidates to other districts. Many administrators agreed with the high school math supervisor in one district who observed, "We are not getting what I consider to be the best people. They are going elsewhere."

Principals often also described competition among schools within the same district for math candidates. This issue of internal competition was related to how centralized or decentralized the hiring process was within a district. Although decentralized, or school-based, hiring has the advantage of allowing principals to choose teachers who would best fit their schools, or for teachers to choose where they prefer to teach, it also creates the possibility for intense competition between schools within the same district (Johnson et al., 2004; Liu, 2004). In our study, a few administrators did describe decentralized hiring systems that disadvantaged certain schools and contributed to staffing inequities within their district.

II. The Role of Geography. Administrators frequently mentioned geographic location as a factor in explaining their district's situation vis-à-vis the math staffing challenge. Location influenced the pool of applicants available to them as well as the competitive dynamics they faced. Across the eight districts in our study, we saw three distinct district experiences related to geography.

Life on the Urban Fringe – Four urban districts in our sample were situated inside or on the edge of the greater metropolitan area of a much larger city. What this meant was that they often competed for math teachers with both a much larger urban district at the center of the metropolitan area as well as nearby suburban districts that were usually more affluent.

Stand-Alone Urban Districts – Three districts in our sample were more isolated than districts such as those discussed above. What this meant was they were relatively shielded from competition from other districts. While they certainly competed with nearby suburban districts for math teachers, administrators tended not to describe the same sort of competitive frenzy as did the administrators in districts located in larger metropolitan areas. They also had fewer

problems with retention, since many of the teachers they hired had local roots and were not likely to leave the region.

Life in the Center – One district in our study is the commercial and cultural center of a large metropolitan region that has many universities that draws students from far and wide. This meant that it had a large supply of young, highly educated individuals. This was a mixed blessing, however, because this population is also mobile and transient. Many recent college graduates did not have local roots, and often moved away from the area after a few years.

III. A Deeper View: Policy and Organization. Factors related to federal, state, and local policy, and to district and school organization also shaped the experiences of districts and administrators. These factors further complicated the challenge of attracting and retaining qualified and high quality secondary math teachers.

Policy Factors – A number of policies appeared to influence the nature of the staffing challenge facing administrators, as well as how they responded to the challenge. These included the federal reauthorization of the Elementary and Secondary Act in 2001, better known as *No Child Left Behind (NCLB)*, state early retirement incentives, alternative certification programs or accelerated routes to teaching, and (as is the case for many urban districts) an increased reliance on state budgets for educational funding.

The highly qualified teacher (HQT) mandates of *NCLB* affected the work of administrators in a number of ways. First, the requirement that schools hire only "highly qualified" teachers restricted the supply of candidates and also reduced administrators' flexibility in hiring. Second, the requirement raised the specter of having to replace current math teachers who, under the policy, were no longer considered "highly qualified." This was especially an issue for the middle schools, where some math teachers were currently teaching under general K-

6 or K-8 certificates, and may have done so effectively for many years, but did not hold subject area certification.

Alternative certification programs did increase the supply of math candidates available to schools and districts. However, administrators, in general, preferred to hire teachers who had traditional preparation.

Another policy that shaped the experiences of the urban administrators was their districts' increased reliance on state and city funding. Urban districts tend to receive a higher proportion of their funding from state and local government, since they are often the recipients of compensatory education funds or, in some cases, have been taken over by the state. As a result, they can be disproportionately affected by budget delays which can, in turn, negatively affect their hiring timetables. According to school administrators, sometimes state or local governments did not finalize the budget until June, which meant that they could not hire new teachers until well past the time when the most desirable candidates had already accepted job offers of other districts.

Organizational Factors – Organizational decisions, structures, and processes also shaped the challenge and affected administrators' ability to respond to it. These organizational factors fell into two areas: instructional decisions and hiring processes.

Districts' decisions regarding how to organize instruction impacted the number and types of teachers they sought. For example, some districts and individual schools responded to pressure to raise math scores on state assessments by reducing the size of math classes or by having struggling students take two math classes simultaneously. This increased the number of math teachers that they needed. The creation of new instructional leadership roles also contributed to the need to hire math teachers since these positions were filled by experienced

math teachers from within the district, whose schools then had to hire replacements. The district's choice of math curriculum could also have an impact on the staffing challenge. Different curricula placed different demands on teachers, which influenced the qualities that administrators looked for in candidates. Some administrators in districts that had adopted a standards-based math curriculum noted that they now needed teachers with a greater skill set and these teachers were harder to find.

The organization of the hiring process also influenced how districts experienced and responded to the staffing challenge. According to the interviewed administrators, the timetable of the hiring process played a significant role in their ability to attract and land desirable candidates. Many administrators felt their districts were relatively successful in hiring quality candidates if and when they were able to hire early. However, when they hired late, as more often was the case, they lost many of the best candidates to other districts.

Several factors contributed to the late hiring: delayed budget decisions, administrator's lack of availability in the summer, and, to a lesser extent, candidates' reneging on signed contracts. In addition, veteran teacher transfer provisions in the district's collective bargaining contract sometimes slowed down hiring, although this did not have as much of an impact as we expected. Despite the fact that the excess and transfer system[2] is often pointed to as a main constraint on districts' ability to hire whom they want and to do so in a timely manner, very few administrators in our study, when asked, saw this as a significant factor. In only one district did the need to accommodate seniority-based transfers play a major role in delaying hiring.

[2] The transfer system refers to a system in which teachers already working in the district can request a transfer to another school that has an opening. The excess system refers to the system by which tenured teachers whose positions have been eliminated (either due to changes in enrollment or in academic programming) are placed in new positions since they have guaranteed employment in the district. These two systems may be linked or may operate separately. Also, districts vary in terms of the role that seniority plays in determining whose transfer request gets approved or where "excessed teachers" are placed.

Delays also resulted from the length of time it took for the human resources office to make and finalize job offers. District human resource (HR) offices varied in their ability to make a speedy offer once a school decided it wanted to hire a certain candidate. Some were able to hire quality teachers on the same day they made a decision, but more had difficulty processing the necessary paperwork and conducting reference checks in a timely manner. And whereas some districts offered contracts to candidates with the understanding that would become official only after being approved (largely pro forma) by the Board, others had to wait until hiring decisions were ratified at the monthly Board of Education meeting before extending contracts. Not surprisingly, HR directors and principals often had somewhat different perceptions of the responsiveness of the HR office, though all seemed to recognize the need to move quickly to hire teachers in shortage areas such as math.

Focus of this Article

Although, as discussed earlier, existing research has identified key patterns in how individuals behave within teacher labor markets that lead to staffing inequities, we do not yet have a clear sense of what drives or accounts for some of these patterns, how they play out in individual districts, or how they apply to the mathematics teaching force in particular. In order to improve our understanding of the school staffing challenge, we need to go beyond describing what is happening to understanding why. What assumptions and preferences guide the behavior of administrators who hire teachers? And how do various policy, organizational, or individual factors enable or constrain districts' and schools' ability to build strong and reasonably stable teaching forces?

Our exploratory study begins to examine some of these issues in the context of the attempts by eight urban districts to recruit and retain secondary math teachers. Our study takes an

organizational approach to examining the challenge of attracting and retaining quality math teachers in urban schools and districts. We began the study by trying to understand how central office and school-based administrators viewed and understood this challenge, and what measures they were taking to address it. Among the questions we wanted to address were the following:

- How do the ways in which districts are organized influence their ability to recruit and retain math teachers?
- What do respondents perceive to be the organizational barriers to successfully addressing the staffing challenge?
- What examples are there of successful structures or interventions that facilitate recruiting and retaining math teachers?
- When faced with the need to hire less than ideal math candidates, what do the district administrators "bet on"—i.e. what is most important to them?
- What beliefs or assumptions about teachers, teaching, and/or mathematics influence how district administrators approach the challenge of recruiting/retaining math teachers?

DATA SOURCES AND METHODS

Sample

For this study, we interviewed forty-three administrators in eight urban districts in the northeastern United States to find out the extent of their problems in recruiting and retaining new middle- and high-school teachers of mathematics, the approaches they have taken (or plan to take) to address these problems, and what has resulted from the implementation of these approaches. Letters of invitation were sent to the superintendents of the approximately 30 districts in the Northeast that have student populations of 15,000 or more and that have high proportions of low income students. Follow-up calls and emails were used to ascertain the

willingness of districts to participate in the study. The sample was purposive. Given the difficulty of getting districts to agree to participate in any study, we did not turn away any districts that granted us permission to study them. However, in determining which districts to emphasize during our follow-up recruitment efforts, we were conscious of building a sample that contained urban districts of various sizes and that were situated in a variety of geographic settings. As the first group of districts agreed to participate in the study, we specifically targeted other districts that would round out our sample.[3]

The Districts

The eight[4] districts that are discussed in this paper include three that have between 15,000 and 20,000 students (Armstrong,[5] Calloway, and Joplin), three that have between 25,000 and 35,000 students (Basie, Dorsey, and Gillespie), and two that have more than 40,000 students (Ellington and Hampton). In all of the districts but Calloway, students of color comprise the majority of students and at least 65 percent of the students receive free or reduced-price lunch. See Table 1.

The eight districts are located in five states and are diverse in terms of their geographic settings. Armstrong, Basie, Gillespie are small- to mid-sized urban districts that are part of larger metropolitan areas; Hampton is similarly situated, but somewhat larger. To one side of each of these districts is a much larger city/district that forms the center of the metropolitan area, and to the other sides are more affluent suburbs. In contrast, Calloway, Dorsey, and, to a lesser extent,

[3] As the study has evolved, we have expanded it to include three large suburban districts (12,000 to 15,000 students) to serve as a comparison group and to help us understand which aspects of the staffing challenge are unique to urban districts and which are shared by other large districts. Data collection in these suburban districts has not yet been completed; thus, these districts are not included in the analysis below.

[4] A ninth district was removed from this study due to our inability to find principals able or willing to participate in the phone interview. From the existing two interviews conducted, it should be noted that this district appeared challenged in many ways, but not enough information about the district could be obtained to include it in the study.

[5] Throughout this paper, pseudonyms are used in place of the actual district names. Names of great jazz musicians were used as the pseudonyms.

Joplin are more isolated geographically; they are not in areas dominated by a much larger nearby district. Finally, Ellington is a large urban district at the center of a large metropolitan area.

Table 1: District Information

		Armstrong	Basie	Calloway	Dorsey	Ellington	Gillespie	Hampton	Joplin
Student Population		15,000	25,000	15,000	35,000	>50,000	30,000	40,000	20,000
District Demo-graphics	% White	35	20	65	15	15	10	10	10
	% Afr.-Amer.	50	30	<5	65	45	35	60	40
	% Hispanic	10	45	30	20	30	40	30	45
	% Asian/other	<5	<8	<3	<3	10	15	<1	<5
% English Lang. Learners		<10	20	<10	<10	20	<10	<10	15
% Free-reduced lunch		65	70	35	80	75	70	80	90
Per pupil expenditures ($)		12,000	15,000	10,000	15,000	15,000	>17,000	>17,000	12,000

Note: Figures provided have been rounded to protect the identity of the districts. Yearly per pupil expenditures are for 2004-2005.

Data Collection and Analysis

In each district, we interviewed the secondary mathematics supervisor(s), the director of personnel and human resources, and three principals (usually two high school and one middle school).[6] In three of the larger districts, where professional development was not overseen by the mathematics supervisor, we also interviewed the administrator in charge of professional development. Prior to conducting the interviews, we asked the director of human resources and the mathematics supervisor to each fill out a one-page questionnaire requesting some basic information about the number of the secondary math teachers in the district, the number of new middle school and high school teachers, etc.[7] The 43 interviews took place between June 2006 and April 2008, and each lasted between 45 minutes and 1 hour 15 minutes. Most were

[6] The individuals we interviewed held a variety of administrative titles. To maintain anonymity and confidentiality, we are referring to those interviewed by certain generic titles – such as human resources director, math supervisor, and principal – even though these titles do not always match individuals' actual titles within their district. For instance, administrators who held the titles assistant superintendent of human resources, director of personnel, executive director of human resources, etc., are all referred to as "human resources director." In one district, two individuals participated in the HR interview, and one is referred to as "assistant HR director."

[7] This was done, in part, to ensure that the time of the interview would not be wasted in attempts to recall or reconstruct the desired data, and to give them time to look up the data if they had the information.

conducted over the telephone, though a small number were conducted in person. Two members of the research team participated in each interview, with one asking questions and the other taking notes. The interviews were semi-structured, with protocols that varied by administrative role. All but two of the interviews were audio-taped and transcribed.[8]

In analyzing the interview data, we used contextual analysis to understand each district's experience of recruiting, retaining, and supporting new math teachers, as well as cross-case analysis to understand patterns and themes across the districts. As a first step, we read through the interviews and created narrative case studies of individual districts to help us understand the data in context and to identify relationships between different elements of the administrators' experiences within a particular district. This process also helped us identify emerging themes in our data and to set up the next part of our analysis. This involved analyzing the interview data by coding and sub-coding based on themes that emerged in the case studies, from the interview data itself, and from the research literature. We then engaged in an iterative testing process, moving back and forth between the themes/hypotheses we had identified to the interview data and the case studies. We also created matrices (Miles & Huberman, 1994) to summarize data and facilitate cross-case comparisons.

Study Limitations

Our study has certain limitations. We studied a small sample of districts located in a particular region of the country.[9] These districts agreed to participate in our study and might be districts that are particularly well-organized and open to scrutiny. We have no reason to believe,

[8] For the two interviews that we were unable to audio-tape, we relied on the detailed notes taken during the interview and took additional steps to flesh them out immediately after the interview.

[9] The Northeastern United States is a region that suffers from a moderate shortage of math teachers (American Association for Employment in Education, 2005) compared with the severe shortages that can be found in other, more rapidly growing regions, such as the Southwest and Southeast.

however, that a district's decision to participate in this study reflected anything other than a particular administrator's taking the time to consider our request and having the willingness to be helpful.

Our study also relies on administrators' accounts—their descriptions of policies and practices, and their estimates, recollections, and informed opinions—although we also collected some limited documentary material. These accounts may not fully or accurately represent some of the practices of their districts or may be based on limited information. However, we have no reason to believe that the people we interviewed were not knowledgeable or candid about their districts' practices and policies; indeed, we found them to be very knowledgeable about the issues that we were discussing with them and very willing to share with us their experiences, their frustrations, and their challenges. We maintain that administrators' perceptions are important and informative, for their understanding of the math staffing challenge and their views on particular policies and practices likely shape how they and their districts respond to the challenge. In our study we strengthened our findings by triangulating data between the multiple interviews within each district, and using later interviews to clarify ambiguities that arose in earlier ones.

Given the nature of our sample and our data, we do not make any claims that our findings generalize beyond our sample. However, we do believe that our data provide a significant window into understanding and appreciating the challenges and efforts at the district level, and provide a reasonably comprehensive list of strategies that districts might adopt to deal with those challenges, as well as some insight into their advantages and disadvantages. The data also allow us to engage in theory and model building as well as point to some promising directions for practice and future research.

FINDINGS

Confronted with a difficult challenge, districts and administrators adopted a number of different strategies for coping. In each of the eight districts, we found practices and reforms that held promise, and we heard about some recent improvements that helped make the situation better than it otherwise would have been. As a group, the districts adopted a range of strategies that attempted to either increase the supply of math candidates or reduce their demand for them by limiting turnover. Certain districts also attempted to make organizational changes or process improvements that would enhance their ability to identify qualified applicants, steer them to schools for which they would be a good match, and hire them quickly before other districts snapped them up. Sometimes, however, faced with the need to fill a position quickly, administrators simply had to compromise and hire less than ideal candidates.

Supply-side Strategies

Administrators' choice of what strategies to pursue appeared to be influenced by how they understood the staffing challenge, and what they viewed as possible and within their control. Because most administrators framed the math staffing challenge primarily as a problem of an insufficient quantity of qualified candidates, many of their strategies focused on increasing the supply of prospective mathematics candidates. Administrators sought to gain the authority to offer incentives to teachers in shortage subjects such as math, expanded their recruitment efforts, and even attempted to grow their own math teachers.

Flexibility in Pay and Incentives. The administrators in our study were well aware of how their salary and benefits packages compared with those of the surrounding districts with which they competed for teachers. Four of the districts (Dorsey, Ellington, Gillespie, and Hampton) were offering salaries that were comparable to or even higher than those in nearby

districts. Three other districts (Armstrong, Basie, and Joplin) reported being in a very disadvantageous position, where they were offering starting salaries up to $5,000 (or 10-15%) less than surrounding districts, and another district (Calloway) reported being in a somewhat disadvantageous situation regarding salary.[10] However, administrators in these four districts did not foresee any dramatic change in their districts' competitive position in the short term, given their current financial and political realities.

Although the administrators in our study did not perceive that they had the ability to make dramatic changes in salary, some realized that they did have some possibility of modestly improving the financial incentives they offered to prospective math teachers. Thus, administrators in three districts (Armstrong, Joplin, and Ellington) negotiated into their teacher contracts flexibility in assigning shortage-area candidates to higher steps on the standard salary schedule as a way to increase the competitiveness of their compensation packages. For instance, according to Joplin's HR Director, in 2004 the district administration was able to negotiate with the teachers union the ability:

> to give up to seven years of [credit for] experience for other than teaching, in shortage areas. So, for example if you've worked in banking for ten years and now you've taken an alternate route program and you're a math teacher, I can start you on step seven, which before we were not able to. Everyone had to start at one if they did not have previous teaching experience. So, that's one area where we try to be a little more competitive…. [We use this] quite often, for the areas that are deemed to be shortage areas.

Each step added an additional $1,000 or so in salary, so seven steps could result in a sizable amount. In two additional districts (Basie and Dorsey), without formally negotiating the authority to do so, the human resources directors used their own discretion to assign high-demand candidates to higher steps on the salary scale.

[10] One of these districts has since negotiated a new teachers contract, so that its competitive position has been improved somewhat.

None of these initiatives involved across-the-board salary increases nor sought to alter the traditional single salary schedule in any appreciable way. Rather, they involved making changes at the margins. Also, it seems likely that these "experience credits" and "discretionary credits" played a bigger role in encouraging the *acceptance* of job offers rather than in inducing a greater number of candidates to *apply* to the district. We did not ascertain whether candidates who had not yet applied or successfully gone through the hiring process knew beforehand of the existence of this practice and the potential for higher pay.

Offering Support and Better Working Conditions as an Inducement. Some districts that were unable to offer even modest pay increases to math teachers attempted to use the promise of support and better working conditions as enticements. In Armstrong, for example, virtually all of the administrators we interviewed mentioned the larger nearby urban district as a tough competitor. The high school principal mentioned that they try to compete in terms of nonfinancial factors, but this has had only moderate success: "We try and provide a lot of attractive features to people in terms of scheduling and classes and mentors, and all that, but the bottom line is that when someone is 22 years old, they have choices, and money often is the variable that helps them make the [choice]." Although this administrator was rather pessimistic about the ability of promises of support to make up for low salaries, others reported success when they combined assurances of support with tours of schools that showed candidates firsthand what it is really like to teach in the school, and gave them a glimpse of the actual school climate and working conditions. This strategy is discussed later in the paper.

Strengthening Relationships with Universities and Targeting Student Teachers. In addition to increasing financial and non-financial incentives for candidates, districts also intensified their recruitment activities. Administrators in all eight districts reported trying to

build or rebuild relationships with local colleges of education to gain access to their graduates. For instance, Dorsey's director of HR describes meeting with the department head for mathematics education at a local public university to try to find out what they could do to place more of their "talented students who had the interest and the potential to be good urban teachers with us." She then worked out a deal that made it easier for this university's math education director to place student teachers in two particular schools that he preferred. She justified this special treatment to other district administrators by saying, "We have a vested interest in letting in those who are of high value to us."

Hampton's HR director also sought to recruit more actively from the pool of college students who were doing their student teaching in the district. As she put it:

> We've had a whole semester to look at them and to check them out. They are already part of our family. We've included them in every aspect of the school, and then if we have staff development, they attend, too. We bring them in. They're taking a look at us and we're taking a look at them. Sometime during the course of the semester when they are here, we have a mini job fair, a reception just for them. *(From typed interview notes)*

Two districts, Ellington and Armstrong, had grant-funded partnerships with universities that placed student interns into schools for extended internships.

Casting a Wider Net and Recruiting from Afar. Asked to describe their recruiting efforts, the HR Directors in our study mentioned the typical set of activities: advertising open positions, sponsoring district job fairs, visiting university campuses and schools of education, and attending regional career fairs. However, other than attending the occasional math-oriented job fair, the districts as a whole had few initiatives for recruiting math teachers in particular.

Two of the geographically isolated districts, Callahan and Dorsey, did recruit teachers from Puerto Rico, though the primary focus for these trips was finding bilingual teachers rather than math teachers per se. Likewise, two other districts, Hampton and Joplin, mentioned

recruiting at historically black colleges though, again, the goal of this was primarily to find teachers with diverse backgrounds rather than math teachers.

Two districts, Joplin and Hampton, had in the recent past recruited mathematics teachers from Asian countries that have many English speakers. For the 2007-08 school year, Joplin recruited 15 experienced high school math and science teachers from abroad with help from an outside agency. These teachers signed up for a three-year commitment, and their work visas were handled through the state. Although the initiative was viewed as a success, one principal, in whose high school two of the math teachers from Asia were placed, observed that the teachers were understandably having difficulty adjusting to the new context:

> The [new] teachers who are experiencing the most difficulty are the teachers from [the foreign country]. They are very sound instructionally—just outstanding instructionally. Their issue is dealing with the vastly different culture…. What we need to do is to figure out a way to provide more support for them to so they can deal with the difference in culture. In [their home country] what they're used to is they walk in the room and the students stand. And then when directed to do so they sit, and they listen quietly to the instructor for the course of the period and do exactly what they're told to do, and they get up and leave when they are told to do so. That's not exactly what they are encountering here.

Hampton had also recruited mathematics teachers from Asia three years prior, with similar outcomes. In both districts, administrators reported satisfaction with the content knowledge and general teaching abilities of the teachers, but described them as struggling at first to adapt to a vastly different cultural and educational context. The administrators further acknowledged that they needed to do more to help these teachers make the necessary adaptations, especially because, despite their initial struggles with classroom management issues, these teachers were not giving up. The administrators we interviewed reported that although experienced foreign teachers face a difficult cultural challenge, many seemed to be able to rise to

the challenge with proper support. It was unclear, however, what would happen once these foreign math teachers' work visas expired.

Hiring Teachers from Alternate Certification Routes. Of the eight districts, Armstrong, Gillespie, and Hampton relied the most on alternatively certified teachers. Approximately 50 percent of Armstrong's new math hires came from this source, and between 25-40 percent of Gillespie's did. Hampton's HR director estimated that probably 50 to 60 percent of the district's hires came through alternate certification routes.

Views about alternatively certified candidates were mixed. Armstrong's high school math supervisor felt that many of the alternatively certified math teachers were only capable of teaching the ninth and tenth grade curricula (i.e., Algebra and Geometry), and that few had a deep enough knowledge of content or pedagogy to teach the more advanced math topics. In his view, then, alternatively certified teachers were not perfect substitutes for traditionally certified teachers. Hampton's Math Supervisor had a more mixed experience, noting that "[t]here are people who can teach the gamut, but there are people who you tend to leave them in the lower level because you're not comfortable with what they will do in the higher end. With time, some of them do very well."

Another Armstrong administrator, and some administrators in other districts, shared that they have had negative experiences with some alternatively certified teachers leaving the district abruptly, which caused them to avoid wanting to hire these teachers in the future. This they attributed either a lack of commitment on the candidates' part or to alternatively certified teachers' lack of formal training or experience. The Armstrong administrator recounted:

> We lost a math teacher who was a former lawyer, who realized, "this isn't for me." It was not a match made in heaven, he resigned on his own. It wasn't about our school, it was about teaching. Some people think that because they went to school, they can teach; some can, some can't.

Others viewed alternatively certified candidates more favorably. Gillespie's high school mathematics supervisor, for instance, observed that: "They can teach full range, especially people in engineering and statisticians…. When they merge and include their life experience, the real-life applications that they do, they make the classroom more attractive to the kids. Great teachers make classroom like a lab. Alternate route teachers can provide a wealth of knowledge." Thus, overall, administrators and districts have had varied experiences with the use of alternatively-certified teachers in their schools. Unlike the teachers from foreign countries who were generally experienced teachers, the alternate route teachers lacked classroom experience, and, although they did not experience the same culture shock as the foreign teachers, they were sometimes surprised by and unprepared for what they found in the classroom.

Partnering with Teach For America. Two of the eight districts in our study (Hampton and Joplin) had partnerships with Teach for America (TFA). In 2007-2008, Joplin accepted its first group of teachers from TFA. Out of the fifteen TFA teachers, however, only one taught mathematics. As the district's HR director, noted, "They don't have any [math teachers] either." Hampton also had a partnership with Teach for America; out of the 38 TFA teachers it brought in at the start of 2007-08, only "one or two were certified with math," according to the HR director.

Grow-Your-Own Strategies. Districts also tried to grow their own math teachers by either sponsoring district-based alternative certification programs or initiating programs that helped current district teachers get additional certification in mathematics. Five out of the eight districts had implemented some sort of grow-your-own strategy. Some of these strategies involved creating and staffing internally run training programs, whereas others provided

incentives for current district employees to go back to a university to get certified in a high-need subject area.

Ellington's HR Director explained that their "key recruitment strategy for math teachers has been certifying [their] own career changers through [the district's own alternative certification program]." Armstrong, Gillespie, and Hampton provided in-house training to teachers with K-6 or K-8 certification with "the math content that they need to get math certified." This strategy also served to reduce the need to replace current middle school math teachers who could no longer be considered "highly qualified" under *NCLB*, so this strategy can be viewed as a demand side strategy as well as a supply side strategy. Dorsey offered sabbaticals with tuition reimbursement for teachers to go back to school to become certified in a new area where there is a high need, and the district also provided tuition reimbursement for paraprofessionals working towards a teaching degree.

Demand-side Strategies

While increasing supply was the focus of the majority of district strategies, administrators in our study also described strategies that involved reducing demand by decreasing teacher turnover. In five of the eight districts (Basie, Ellington, Gillespie, Hampton, Joplin) administrators felt that teacher turnover was a major challenge. In two others (Armstrong and Calloway), administrators felt that they did not have a retention problem and were doing a very good job keeping teachers once they hired them. In the remaining district (Dorsey), administrators' perceptions about retention were somewhere in between, due to the district's past problems with the turnover of alternate route teachers and its unwillingness to renew those who it perceives to be low-quality teachers.

Some administrators distinguished between retention and turnover. As the secondary math supervisor in Ellington put it:

> I don't think we have a problem retaining people we want to retain. We have a turnover problem, but I'm not sure we have a retention problem, and that's an important distinction. When we find good teachers, they stay with us, with the possible exception of some life changes that everybody has. We have very few math teachers that we lose who we think are terrific that go off to someplace else because they don't like us. Generally speaking, the ones we want, we keep.

Two other Ellington administrators appeared to view some of the turnover as inevitable because many of their new hires were graduates of local universities but were not local to the city, and many of them could be expected to leave the district eventually and return to their home communities. Thus, although administrators in five of the districts thought that replacing math teachers was a major challenge, not all felt that they had difficulty in keeping the teachers that they really wanted to keep and regarded as keepable.

Providing Supports for New Teachers. District administrators described in detail a variety of induction and support programs that they provided to new math teachers. These included mentoring, support from coaches and instructional leaders, workshops, and other professional development activities.[11] Administrators also regularly discussed these support programs with prospective teachers; indeed, many mentioned that the prospective teachers whom they interviewed asked about such support. Because ours was an interview study, we had no information about the quality and effectiveness of these programs. However, administrators did speak about the link between support and the retention of new teachers, and in at least two districts, Armstrong and Dorsey, administrators attributed their relative success in retaining teachers to their comprehensive support programs.

[11] We did not find, however, a single urban district or school that reduced the teaching load for novice teachers. A few principals did mention giving their new teachers lighter non-teaching duties.

In Armstrong, one of the district's schools has had considerable success in terms of retention. Over the past 3-4 years, virtually no math teachers have left this high school voluntarily. Openings are mainly due to retirements or to dismissals for poor performance. The high school's department chair attributes this to the many supports that the school has in place for math teachers:

> We are very good with working with and supporting new teachers… We have a number of programs [in place] that really…make people feel comfortable and also make people understand that we're asking them to grow and not necessarily be experts when they show up here.

Each new teacher is assigned a mentor, who is paid a modest stipend of $1,500. The department head feels he is able to pair new teachers with very capable experienced math teachers. The high school's math department is led by a chair and supported by an instructional leader who is similar to an assistant chair. One of the instructional leader's main tasks is to work with and support nontenured teachers. They do informal observations, confer with teachers, help with planning, and provide assistance in whatever areas the teacher needs. Their work with the teachers is confidential and non-evaluative. In addition to the non-evaluative support and informal observations, teachers in this school are formally observed six times a year, more frequently than in most other schools.

In addition to support from administrators and quasi-administrators, teachers in this Armstrong high school benefited from support from colleagues. The school is divided into academic houses. Math teachers in each house share a physical office space and are led by a lead teacher. As the department chair observed, "A new teacher in one of these offices not only has their mentor, but they really have 9 or 10 other mentors or people working with them."

Furthermore, in this school, there is a New Teacher Committee that helps new teachers assimilate socially and professionally. A suggestion from the New Teacher Committee inspired

another support effort called the Teacher as an Observer; where new teachers are relieved of their teaching duties by substitutes so that they can observe master teachers in areas they are deemed in need of support. Finally, other supports in Armstrong include a district orientation before the start of the year, and a new teacher institute (open to all teachers) consisting of 8-10 one-hour workshops in the fall and 8-10 in the spring.

Dorsey was another district that had comprehensive support programs for new teachers. Its mentoring program offers new teachers up to three years of systemic support. New teachers are introduced to their mentors right away, and mentors typically start working with them very soon after they are hired, i.e. before June. Even if school is not in session, mentors contact new teaches to plan lessons. Dorsey also promotes collaboration with the Teacher Buddy System, where teachers can observe each other and share lesson plans.

Fostering a Collegial School Culture. Like the administrators in Armstrong, administrators in many schools (i.e., in at least one school per district) attributed the retention of teachers to the collegial and supportive culture of their school. Some administrators described how their math teachers would support one another and were also social and friendly outside of school. This strategy was, by in its very nature, more of a school-based strategy than a district-based strategy, although district support for building collegial school cultures can certainly make a difference. The HR director from Joplin also attributed the success of some district schools over others in their retention of teachers to:

> Providing a culture where somebody wants to work….I have schools that match one another by student population, administrative population, a lot of factors, and I have one school that has a ... 17% turnover, and one school that has a 0% turnover. … Why is this happening? … You have to look at the culture of the school. Do teachers have planning time, do they work together for the benefit of all kids, is there administrative support for teacher edification, and so on and so forth. So there are a lot of factors as to how, whether a teacher is going to be successful or not, but research says that administrative support is

> the number one determinant in success, and those are the schools that are successful in not only getting the best people, but keeping them, too.

Indeed, everyone interviewed in Joplin spoke to the importance of a supportive climate for teachers. Working in a district where many teachers were being lured away by nearby suburban districts, administrators in Joplin seemed particularly attuned to the importance of this strategy for retaining and preventing the further loss of teachers.

Certifying K-6, K-8 Teachers who Currently Teach Middle School Math. The teacher quality mandates of *No Child Left Behind* raised the specter of having to replace current math teachers who, under the policy, were no longer considered "highly qualified." This was especially an issue for the middle schools, where some math teachers were currently teaching under general K-6 or K-8 certificates and did not hold subject area certification. Although the NCLB mandate was intended to eliminate those lacking the appropriate credentials from teaching mathematics, it also eliminated those who did not formally meet the new requirements but had valuable experience and expertise from teaching mathematics at the middle school level for a number of years. Three districts, Armstrong, Gillespie, and Hampton, anticipated this potential problem and attempted to head it off. The middle school math supervisor in Gillespie described a training initiative that the district had put in place to help current middle school teachers get certified in mathematics. Without this initiative, the district would be in a much more dire situation:

> If a lot of our teachers were not pursuing the middle school math cert[ification], then there would be a mass exodus from 6, 7, 8, and then we'd have a massive shortage. Since a lot of them are doing that and they are getting ready, that's going to cut down on the need to hire.

Thus, the district reduced its demand for new teachers by ensuring that these math teachers would have an opportunity to stay in their positions.

Organizational Reforms and Process Improvements

Administrators whom we interviewed adopted a number of practices related to reorganizing district recruitment and hiring practices. Although districts operated under certain constraints—such as the timing of the state budget, hiring freezes, or the requirement that they honor veteran teachers' transfer rights—several districts reported making changes that allowed them to start the hiring process earlier, process applications more efficiently, improve the collection and flow of information between the district personnel office and school principals, and extend job offers on a timely basis. Making these changes required coordination, altering well-established processes, and/or utilizing new tools such as information technology.

Reducing the Impact of Seniority-Based Hiring. Although in Basie, the transfer process had a major impact on the timetable for hiring new teachers, this was not the case in the other districts. In two districts, Dorsey and Ellington, the transfer process did slow down hiring, but its impact had been greatly reduced by negotiating to begin the process earlier and reducing the role that seniority automatically played in placement decisions. In Ellington, moreover, certain types of positions could be "open posted" and be made to bypass the transfer process entirely. In the five other districts, administrators said that they were in no way contractually bound to honor a veteran teacher's request to transfer schools or change positions, and thus this had little to no impact on their capacity to hire quality math teachers expeditiously. Overall, the seniority system appeared to have a rather limited impact on the hiring of math teachers across the eight districts.[12]

Offering Letters of Commitment Before the Budget is Set. Districts also found ways to cope with uncertainty about the budget, which would otherwise compromise their ability to hire

[12] In most of the districts this was the result of changes in the hiring process that had taken place in recent years.

early in the season. Some districts, including Hampton and Joplin, were not allowed to offer contracts to candidates until the budget was passed and money came through, which was sometimes as late as June. The HR director of Hampton painted us a picture where she had 22 math teachers retiring, but because the district had a large deficit, she wasn't allowed to hire because the budget had not be approved. "[But,] suddenly it's August 1st, HIRE! Now all of your best candidates are gone… we can't make a definite commitment, they understandably had to go elsewhere so it's very frustrating."

Half of the districts in our study—Dorsey, Ellington, Gillespie, and Joplin—offered letters of commitment, letters of interest, or provisional contracts (promising a position in the district but not at a specific school) to candidates as a way of coping with uncertainty about the budget. Administrators tried to develop and justify a projection of math teacher openings for the coming year and obtain permission from superiors to hire the projected minimum number of math teachers needed before the budget was actually approved. Gillespie, for instance, had started giving out early district contracts to the most highly recommended math candidates, knowing that it would have at least a certain number of math vacancies.

This strategy, however, met with mixed success, because these letters were often not binding or because candidates did not value them. Dorsey's HR director observed that math candidates, since they knew they were in high demand, typically were unwilling to accept contracts to the district as a whole without having an exact school placement. And although Gillespie did offer candidates formal contracts of employment with the district, either the candidate or the district could separate from the contract with sixty days' notice. Nevertheless, this was a tool that conveyed to applicants that the district was committed to hiring them, even though the constraints that they faced precluded their acting on that commitment until later.

Providing Incentives for Early Notification of Intent to Retire or Resign. Another tactic that districts sometimes employed to reduce the amount of late hiring was to encourage veteran teachers to let them know early of their intentions to retire, so that the district would know how many positions it had to fill and could recruit and hire appropriately. When teachers waited until late spring or summer to inform administrators that they were not coming back for the next school year, administrators would have to look for replacements when high quality candidates were in short supply. Joplin tried to address this problem by stipulating that teachers would receive their longevity stipend the first year they retire if they announced their retirement intentions by April 1st.

Dispelling Stereotypes about Urban Schools with School Visits. The administrators in our study often bemoaned the fact that candidates often had negative stereotypes about urban schools and students that prevented them from applying. However, they also noted that, if a candidate actually visited one of their schools, they were often surprised by how much nicer it was than their expectations.

Joplin's HR director described a practice, in its third year, of taking candidates to see district schools:

> They spend a day; we have lunch; we answer their questions. And we do a couple of these days based on subject areas. And they meet our principals, meet our students, they see our school district, because we feel it's necessary for them.… It's good for two reasons: people get to see us; we see get to see them. But it also dispels the myth about what happens in urban districts. Because what you read in the paper is often negative…. But oftentimes, after candidates have been in our schools and they've spend a day with us, they say, "I'm shocked, this school really looks great, I'm shocked, I want to work here." So, it's a marketing tool that is effective.

This strategy appeared to have two benefits. It dispelled certain myths about teaching in an urban setting for those who had overly negative images of urban schools, while also providing a reality check for those who might have overly positive or simplistic images of urban teaching. Although

having candidates spend time at a school might not succeed in convincing every candidate to teach in the district, it can certainly make a difference in getting the right teachers to sign on—i.e., candidates who are a good fit for the school and who have realistic expectations. Indeed many administrators in our study, particularly the principals, talked about the importance of being candid with candidates about the challenges of teaching in an urban setting. Even while they mentioned some of the positive aspects of teaching in their schools and the supports they provided to new teachers, they were wary of painting an overly rosy picture.

Changing the Balance between District Centralization and School Autonomy. The districts in our study varied in how they divided responsibility for hiring between the central office and individual schools, and among principals, HR personnel, and math supervisors. In all of the districts, however, principals played a major role in hiring decisions. As part of their strategies to address the challenge of recruiting and retaining teachers, some districts adjusted the balance between centralization and decentralization of the hiring process. Movements toward decentralization sought to reduce hiring bottlenecks and bureaucratic delays, empower principals, and ensure that teacher candidates and schools made good matches. Movements toward centralization sought to reduce duplication of effort and competition between principals, create more uniformity in hiring standards, and also address issues of equity by targeting teacher resources to schools where the need is greatest. The two case studies below provide examples of districts' adjusting the balance between centralization and decentralization within the context of broader improvements in human resources practices.

Improving Human Resource Practices – Two Case Studies. Although all of the districts pointed to some examples of changes that they had made in improving human resources

practices in recent years, Calloway and Ellington had taken the most concerted efforts to improve their human resource processes.

Calloway's Improvements – Administrators in Calloway generally agreed that, for many years, hiring started too late in the year, and the district lost many candidates as a result. Until quite recently, job openings were not posted until June, and most hiring occurred in July and August. The hiring process was largely decentralized, and schools recruited, evaluated, and hired candidates mostly on their own. A middle school principal, in his 23rd year as an administrator in the district, described the frustration he used to feel:

> I've been here a long time. My position has been that we [were] missing the most qualified people. Are we stupid here? We posted our positions late! Everyone is running around on their own trying to find people, doing it on their own—no central process. For example, one of my daughters was hired before she graduated from college. If other districts can do it—and they are—we're getting what's left over.

There was also some concern that hiring procedures were uneven, and communication and coordination poor. One of the high school principals described the prior system in the following manner:

> It used to be all schools for themselves, depending on their connections…. We had schools fighting one another and not knowing it. We had people who didn't know other jobs were available; multiple applicants at one school and not at another; other schools not knowing about positions; no system to share candidates with other schools.

In 2005-2006, a new director of human resources arrived in Calloway. He put together a committee consisting of two principals from each school level (elementary, middle, and high), one of the district curriculum supervisors, and himself, to rethink and make changes to interviewing process. The key changes included:

1. Starting the recruiting and hiring process earlier. In December, the director of human resources now sends out a letter to all personnel requesting "a declaration of intent" regarding the next school year—i.e., do they intend to retire, resign, take a leave of absence, etc? He also

looks at the seniority list to see if there are any possible retirees based on 35+ years of service. Using both sets of information, he develops a very preliminary list of anticipated vacancies, and the district starts advertising and getting in touch with colleges in January.

2. Introducing an initial, centralized step in which promising candidates are interviewed and asked to teach a brief demonstration lesson in front of a team of principals and central office administrators. Based on this interview, teaching demonstration, and other factors, candidates are assigned a score using an algebraic formula and placed on an ordered list. This step may occur prior to the posting of any openings, and in 2005-2006 these preliminary interviews began in April. Once they know they have an opening, principals consult this list and determine which candidates to bring in for a school-level interview. In almost all cases, the principal's recommendation is followed. Job offers can be extended anytime after they know there is in fact a vacancy based on a formal letter of resignation or an approved leave.

3. Creating a procedure for resolving conflicts that arise when two or more principals want to hire the same candidate. In the past, principals could make competing offers, and it was left to the candidate to decide which offer to accept. Now, administrators who are interested in the same individual "MUST confer regarding the candidate to determine greatest need and 'best fit'" (from a district handbook; emphasis in original). If the principals cannot decide among themselves who will first get to offer the candidate the position, then the director of human resources is brought in to make a decision.

4. Utilizing a web-based portal to collect, store, and view candidate's applications. Calloway pays to use a third-party online system that allows districts to post openings and accept applications through the site. In 2005-06, candidates could either apply through this web portal

or submit paper applications. Beginning 2006-07, the district asked all candidates to submit applications electronically through this portal.

Early reviews of these changes have been positive. Principals we talked to appreciate the earlier timeline and the compilation of the ranked list, although they do not particularly enjoy leaving their schools to participate in the initial interviews in central office. The online portal has also gotten good marks. One high school principal remarked, "The [online] system enables you to easily access information about teachers if you have their name, and it allows screening online rather than waiting for folders to come from the [central office]…. You can work with resumes on your own time and not have to worry about returning material to HR."

The changes did have some "bugs in the first year" and introduced some new wrinkles. For instance, a couple of the early job offers backfired when teachers who accepted offers in May or June later changed their minds in August and resigned after they received a job offer from another district. Also, a middle school principal felt that even more consideration needed to be given to the challenges that his and other low-SES schools face: "The [director of human resources], from my position, should give the best candidates to the kids who need them the most."

One interesting thing about these changes is that instead of leading to bureaucracy and delay, as might be expected, centralization and standardization have actually sped up the process and helped Calloway principals hire the people they want. Technology has helped streamline the process and improve the flow of information, and also appears to have helped the district develop a new system that strikes a balance between centralization and decentralization.

Ellington's Improvements – Ellington started off with one advantage in terms of attracting candidates to the district. It had relatively high starting salaries. At the same time,

however, it was a large district with a long history of difficult management and union relationships and a large bureaucracy. Ellington was also one of the three districts in the sample where openings had to be posted internally and run through a transfer and excess process before principals could hire an external candidate. This process used to delay the consideration of any outside teacher candidates until the summer. For instance, until a few years ago, principals could not interview, let alone hire, any external candidate until after June 1st.

Over time, as one high school principal observed, "[Ellington] Public Schools has done a lot to improve its collective bargaining commitments that in the past have inhibited the ability to recruit and retain good people. We've come a long way, but I'd [still] like to be able to hire earlier in the spring without being held up by the transfer and excess process. But they have done a lot to expedite this process." Even with the district's transfer and excess system in place, it was his view that "90-95% of hiring decisions are school-based, depending on the year."

Some of the key improvements that Ellington had made include:

1. Earlier job postings – Ellington has put a great deal of effort into making it possible to post jobs earlier in the year, by negotiating changes to the teachers contract that push up the dates of the internal transfer and excess process, and by improving organizational processes and procedures. In 2005-06, the district posted its initial round of openings in mid-February, which was significantly earlier than in previous years, when the first posting occurred in April or May. In addition, whereas the district once had a series of postings, "now it's just rolling, in real time. Once the initial jobs go up, it is rolling after that," according to the HR director. In 2006-07, the district was able to post the first round of openings even earlier, around February 1st.

2. Negotiating and creating more opportunities for open posting – The district has also negotiated the opportunity for principals to bypass the entire transfer and excess process for

certain “unique” positions. This is called “open posting” a position, which means that the school can consider external (as well as internal) candidates immediately rather than wait until late April, when the transfer process is typically concluded. Positions can be “open posted” either through a vote of the school faculty or by attaching additional stipends and/or responsibilities to the position. Furthermore, a certain set of schools that have been identified as needing improvement are allowed to open post up to fifty percent of their job openings.

3. Use of Technology – Like Calloway, Ellington has adopted information technology to support its recruitment and hiring activities. Candidates now submit their applications online, and their information is automatically captured in a database. The district’s director of human resources described the impact of their new online system, which was fully installed in the summer of 2005:

> For us, historically, a challenge has been connecting those applicants to the people who are making the selection decisions, which are the schools and principals. But that is one of those problems that we’ve done a lot to solve with an online system, which allows principals to search for any licensed math candidates in the entire database, and allows us to quickly find and forward resumes and attach applicants to jobs, those kinds of things. The technology has helped us a lot. And I think, in some ways, maybe the applicant pool wasn’t as small as we thought it was. We just weren’t as efficient in mining it and connecting those applicants with those principals who were hiring for those positions.

The year 2006 was the first hiring season with the system up and running, and it was the first time in many years that the district had a surplus of qualified math candidates.

4. Provisional Contracts or Letters of Interest. For shortage areas such as math, science, and special education, the district has offered “early contracts” to candidates. However, according to the director of human resources, the offers “are not binding, so they’re not really contracts…. They are almost more letters of interest, with a commitment to helping them get a job, but they’re not legal contracts. This year we’ll probably change it so the offers are a legal contract for the district as a whole, and we’ll work to find them positions.”

The other six districts in our study did not make as sweeping changes to the organization of their hiring systems as Calloway and Ellington. However, administrators in most districts did try, at least to some extent, to improve the processes of recruitment and hiring of teachers, in order to confront the challenges presented.

Coping by Compromising

Organizational changes and process improvements can make a difference in districts' ability to recruit and retain high quality mathematics teachers, as the above two cases illustrate. Still, urban administrators rarely found individual candidates who had what one referred to as the "whole package" of necessary and desired qualities, particularly in the shortage context. Often, they faced a dilemma: how to reconcile their view that teaching in urban districts was much more difficult than teaching in suburban districts and required a longer list of skills, abilities, and experiences, with the reality that they often had fewer teachers to choose from. If they held out for the entire list of desired criteria, they might be on an impossible quest. However, if they did not ensure that a candidate had enough of what it took to reasonably succeed, they would likely be in the situation, quite soon, of having to replace the individual and rehire for that position (either because of voluntary departure or dismissal). One high school principal in Basie found himself caught in a revolving door. He was fully aware that, because of the small candidate pool,

> some of the people who I am getting now, in an attempt to hire people and fill gaps, are not making it past the first or second year because of performance. So, what I am being forced to do is to hire and bring in candidates or teachers who are less qualified than they need to be. Consequently they can't do the job and are let go after a relatively short period of time.

Administrators found themselves in the position of having to compromise and make tradeoffs in hiring math teachers. When we asked them how they made these tradeoffs, their responses often reflected their views of teaching quality, in terms of the characteristics they saw

as most important for successful urban teaching, as well as the characteristics they felt they as an individual and organization could most easily compensate for by offering training and support. For instance, Armstrong's middle school mathematics supervisor bet on classroom experience and management skills in part because she saw an orderly and positive learning environment as an important prerequisite for effective teaching and also felt the district could compensate for a lack of content knowledge. As she put it, "If you don't have management [skills], it doesn't matter how much content knowledge you have." Implied in her response was her view that classroom management skills were less easy to "teach" to teachers. Another reason she placed such an emphasis on classroom management was because the type of investigatory mathematics her district's curriculum promoted worked best with a more fluid, student-centered classroom environment. Creating such an environment was difficult and required strong classroom management skills. Thus, in making difficult compromises, administrators appeared to be influenced by individual views and assumptions about successful urban teaching as well as by organizational decisions and needs.

A second type of compromise that districts needed to make involved choosing between long-term prospects versus short-term needs. Having a more stable labor force is every district's desire. However, administrators often resorted to filling positions with teachers from abroad, with candidates from Teach for America, and with recent college graduates who were likely to relocate. These did not appear to be long-term recipes for a stable mathematics faculty. District administrators were well aware that many of the teachers that they hired might be there only temporarily, but they often had little choice—and so the math teachers' door continued to revolve.

A third type of compromise was, in a way, the most distressing. When there was a great shortage of candidates and/or it was near the start of the school year, finding any certified teacher often became the sole focus. This however, was often unsatisfactory and even wrenching for administrators. As a high school principal in Armstrong described,

> The challenge is when it is late summer and we just can't get anybody for an empty position, and we are desperate enough to hire a less than qualified teacher. I've had to say, "Are we this desperate?" I grew up here and I picture those kids in their classroom and look at their faces and think, "This is not fair!" Even if it does not happen often, even if it happens once, it is once too many, because it is not about statistics, but about the students whose education will have been stolen away from them by this less than qualified candidate.

It should be noted that in the *NCLB* context this comment refers to a teacher who on paper is "highly qualified," but from the principal's perspective is still not qualified to teach her students.

DISCUSSION

Types of Policy Instruments Utilized in District Strategies

The strategies that districts in our study used to cope with the challenge of filling their math teaching positions ranged in scope: from modest increases in incentives, such as the ability of HR directors to credit applicants with additional steps on the salary schedule, to more sweeping system changes, such as establishing district-run teacher training programs or altering the balance between centralization and decentralization in the hiring process. These strategies also varied in terms of the policy instruments (or levers) that they utilized.

McDonnell and Elmore (1987) define policy instruments as "the mechanisms that translate substantive policy goals into concrete actions" (p. 134), and define four classes of instruments:

- *mandates* are rules governing the action of individuals and agencies, and are intended to produce compliance;
- *inducements* transfer money to individuals or agencies in return for certain actions;

- *capacity-building* is the transfer of money for the purpose of investment in material, intellectual, or human resources; and
- *system-changing* transfers official authority among individuals and agencies in order to alter the system by which public good and services are delivered. (p. 134)

They argue that each class of policy instruments rests on a unique set of assumptions. Mandates, for instance, assume that all individuals or organizations ought to be governed by the same rules, regardless of the differences in their circumstances or capacities. They also assume that the benefits arising from imposing greater uniformity outweigh any lost benefits from variation. Inducements (or incentives), according to McDonnell and Elmore, implicitly assume that the absence of money is what is preventing the desired outcome, and that money is an effective way to elicit the desired performance. An even deeper assumption of inducements is that the capacity already exists in the targeted population to produce the desired outcome but that it just needs to be channeled correctly. Capacity-building, on the other hand, assumes that such capacity does not currently exist but rather needs to be developed. Capacity-building is often prompted by "fundamental failures of performance by some set of individuals or institutions" (p. 143). Finally, system-changing assumes that the existing institutions and incentives are incapable of producing the desired results. Moreover, this approach assumes that "altering the distribution of authority among institutions, by broadening or narrowing the type of institutions that participate in the production of things of public value, will significantly change the nature of what is produced or the efficiency by which it is produced" (p. 143).

Although the strategies and practices we examined in this study did not all constitute formal policies per se, McDonnell and Elmore's framework provides a useful tool for understanding many of the actions that districts took to address the challenge of staffing their schools with high quality math teachers. The strategies that districts employed reflected a variety of inducements, capacity-building efforts, and system changes, but no mandates; however, many

of the strategies they employed were, to some extent, responses to the mandates placed on them by NCLB. Some strategies involved offering inducements to encourage candidates to apply and to accept job offers. Others involved capacity-building and investment in material and human resources: for example, training K-6 and K-8 teachers to help them become certified to teach math (and, hopefully, improve their actual ability to teach math); providing school-based support to new teachers to increase their success and their retention; investing in the use of information technology and their ability to communicate with and track applicants; or investing in the ability of personnel in the HR central office to perform essential new functions. In a few cases, districts engaged in more far-reaching system change, altering the centralization/decentralization of the hiring process, or instituting a district-run program that was authorized to train and certify new teachers.

Some strategies aimed at addressing the same aspect of the staffing challenge utilized different policy instruments. For instance, a common response of administrators was to attempt to use inducements to increase supply. However, some administrators appeared to have a more complex view of supply, seeing it as a more dynamic, time-dependent variable. These administrators observed that supply fluctuated throughout the year and noted that when they were able to make hiring decisions early, they were typically quite successful in getting highly quality mathematics teachers. When they hired teachers in the middle to late summer, the pool of candidates was much smaller and weaker. These administrators sought to improve the ability of their district to make job offers to candidates early, and saw this as within their control. They attempted to alter organizational structures and processes, which involved capacity building and, in some cases, system change. Thus, we saw administrators in both Callahan and Ellington making changes in terms of what parts of the hiring process were centralized or decentralized,

and shifting certain responsibility and authority for certain matters either from the central office to individual schools or from the schools to the central office. We also saw both districts investing in and strategically employing information technology to improve information flow and speed up the hiring process. Indeed, in the case of Ellington, we saw that they had, for the first time in recent memory a surplus of qualified mathematics teachers in 2006-07. As noted above, the district's director of HR mused: "I think, in some ways, maybe the applicant pool wasn't as small as we thought it was. We just weren't as efficient in mining it and connecting those applicants with those principals who were hiring for those positions." As a result of implementing a new strategy, she had come to a new understanding of the nature of the supply problem facing her district.

As we discuss below, the strategies that appeared to be most promising—based on the reports of administrators—were those that involved capacity building or system changes. Strategies that relied on inducements seemed less successful, perhaps because the size of the financial incentives offered were quite modest and insufficient to alter applicants' behavior and decisions in dramatic ways, although they certainly might be helpful in individual cases.

Administrators' Choice of Strategies: Challenges, Constraints, and Capacity

Administrators' strategies and their reported success appeared to reflect an interaction between three types of factors: (1) the particular nature of the challenge facing their district, (2) the constraints (both real and perceived) that administrators faced, and (3) the organizational capacity that the districts and schools had or were able to build. Each of these three types of factors – challenges, constraints, capacity – is discussed in turn.

Challenges: Variation in District Context and Experience. Although the districts in our study experienced many of the same challenges with regard to staffing their classrooms with

high quality mathematics teachers, they also differed in terms of which aspects of the staffing challenge were most severe or problematic for them. Table 2 provides information that sheds light on some differences in the context and challenges across the eight districts studied.

Table 2: Variation in District Context and Challenge

	Armstrong	Basie	Calloway	Dorsey	Ellington	Gillespie	Hampton	Joplin
Geography	Urban Fringe	Urban Fringe	Stand Alone	Stand Alone	Urban Center	Urban Fringe	Urban Fringe	Stand Alone/ Far Fringe
Small number of applicants per math opening	X	X	X				X	X
Large Salary Disadvantage	X	X						X
Hiring Delays a Big Challenge		X	(X)		(X)	X	X	X
Principals Not Contracted to Work Summers	X	X						
Size of Student Enrollments	15,000	25,000	15,000	35,000	>50,000	30,000	40,000	20,000
% Low Income (FRL)	65	70	35	80	75	70	80	90
Per Pupil Spending (04-05)	12,000	15,000	10,000	15,000	15,000	>17,000	>17,000	12,000

(X) = Problem in recent past but greatly reduced by the time of our study.

For instance, as was mentioned earlier, geographic location and the nature of the local labor market often shaped these district's experience and responses. Stand-alone districts such as Calloway, Dorsey, and Joplin, were more likely to report initiatives that sought to recruit teachers from afar and went as far away as Puerto Rico and Asia in search of teachers in shortage fields or teachers of color. Administrators in these districts were more likely to focus on the insufficient supply of math teachers in their region rather than competition from surrounding districts. These strategies had somewhat mixed success, since it was sometimes difficult to attract teachers to their somewhat remote locations. For instance, Dorsey's math supervisor observed that her district "struggles with bringing people in from a distance. That has not been successful….Our rate of bringing people in from other cities was not good at all."

In contrast, districts located in or near larger metropolitan areas seemed less likely to recruit from afar as a method of increasing supply. They were situated in areas with highly educated workforces, and were able to hire many candidates who were switching careers or who, as graduates from local colleges, were looking for teaching jobs in the short term but likely to leave eventually for other geographic regions. Thus, Armstrong, Ellington, Gillespie, Hampton, and Joplin (which was stand-alone but also located 60 miles from a large metropolitan area), relied the most on alternatively certified math teachers or teachers from Teach For America.

In addition to geography, districts varied in terms of financial resources and how competitive their salaries were. Per pupil spending in the eight districts ranged from $12,000 to over $17,000; some districts were spending 50 percent more per pupil than others. Starting salaries (BA, Step 1) also varied greatly – from just under $40,000 to nearly $50,000 in one exceptional district—although most salaries were in the low to mid 40s. Half of the districts offered salaries and benefits that were on par with neighboring districts, whereas half offered salaries and benefits that were considerably lower. Thus, the experiences of a district, such as Basie, which lost candidates to nearby districts with starting salaries that were at least $5,000 higher, was different from that of a district, such as Ellington, whose starting salary was among the five highest in its state. Administrators in districts with low salaries were, understandably, more likely to seek ways to in increase the incentives they offered candidates, although their ability to do this was limited by many constraints.

Districts also varied in size, scale, and organizational complexity. Three districts had between 15,000 and 20,000 students (Armstrong, Calloway, and Joplin); three had between 25,000 and 35,000 students (Basie, Dorsey, and Gillespie); and two that had more than 40,000 students (Ellington and Hampton). For the larger districts, coordinating the recruitment and

hiring process and processing applications in a timely manner seemed to be a larger challenge than for the smaller districts. Administrators in the larger districts were more likely to complain about delays in the hiring process and how this hindered their ability to get high quality math teachers.

Finally, districts varied in terms of student demographics and community perceptions about what it was like to teach in their schools. Although virtually all administrators reported that negative stereotypes about urban schools often made recruiting applicants difficult, some districts had greater proportions of high-need students than others. Thus, a district like Joplin with 90% of its students eligible for free and reduced lunch was quite different than a district like Calloway, with only 35% of its students eligible for subsidized lunch. From the outside, some districts may have appeared to candidates as more challenging places to work than others. Perceptions of the districts were not simply based on simple demographics, however. They also extended to the history of management-labor relations. Basie's administrators reported that a history of recent teacher layoffs and problems renewing the teacher contract impacted the number of applicants they received.

Thus, one way of understanding administrators' choice of strategies is in terms of the variation in district context and complexity. The situation facing each district in our sample was somewhat unique, and the administrators in each district had to respond to the challenges that they faced.

Constraints

Administrators' strategies for coping with the staffing challenge were also influenced by real and perceived constraints, however. These constraints prevented them from instituting some strategies or practices that they might otherwise have pursued.

NCLB Mandates. One obvious constraint that districts faced was that, under *No Child Left Behind,* administrators could no longer hire teachers who were not fully certified to teach or who did not have a college major or substantial coursework in the core academic subjects. Whereas, in the past, administrators could hire a teacher whose certification status was not entirely in order but whom they expected would soon be fully certified, they no longer did this, for fear of not meeting the NCLB mandates. As noted earlier, they sometimes had to rule out rehiring a teacher who had demonstrated quality but was not "highly qualified" in favor of a teacher who was "highly qualified" but was not a teacher of quality. Some districts (Armstrong, Hampton, and Gillespie), anticipating that they might have to replace some of their experienced teachers as a result of NCLB, provided them with training that would enable them to become certified in mathematics and/or demonstrate that they were highly qualified through the HOUSSE (High Objective Uniform State Standard of Evaluation) provision.

Constraints on Incentives. Although administrators were aware that low salaries were contributing to the scarcity of math candidates, few saw any prospect of providing significantly larger incentives for teachers of shortage subjects, especially in the short term. Some districts— particularly those, such as Armstrong and Joplin, whose administrators most keenly felt that their compensation packages were subpar— did attempt to address the supply problem by gaining the ability to offer teachers of shortage area subjects additional steps on the single salary schedule. In other districts, even though no formal policy existed to authorize this practice, some HR directors used their discretion to place highly desirable candidates higher on the salary schedule than their experience levels warranted. Most of these incentives were relatively modest and were implemented within the framework of the traditional single-salary schedule. They certainly did not rise to the levels that Hanushek et al (2001) estimated as the necessary wage premiums (20-

50%) needed to entice a candidate to teach in a school with high concentrations of low-income students and students of color. Given their inability to use pay in dramatic ways to address to the staffing challenge, administrators naturally focused on other strategies that did not involve huge outlays of money.

Budget Delays and Hiring Policies. Districts varied in terms of how much they were subject to uncertainty about the budget. Four districts in our study were particularly affected by budget delays due to various state policies, regulations, and governance structures. However, even within this group of districts that were most seriously affected by budget delays and uncertainty, administrators varied in how they viewed this constraint and whether they took active measures to cope with it. Some districts strictly held off on any hiring decisions until the budget was finalized, which led to a rush to hire late in the summer and the perceived loss of the best candidates. Others used letters of commitment or provisional contracts to express interest to or actually hire promising shortage area candidates even without a budget, which often resulted in their hiring some good candidates. Paradoxically, hiring good candidates early occasionally put the districts in a worse position —that happened when candidates got offers from other districts and then reneged on these early offers.

Teacher Transfer Provisions in the Collective Bargaining Agreement. Still another constraint involved provisions in the teacher contract that gave veteran teachers within the district the right to bid for open positions before outside teachers could be hired. This, however, was reported by only one district (Basie) to be a serious constraint on their hiring process. In two other districts, Dorsey and Ellington, this had been a problem in the past but, notably, they had greatly reduced the impact of the excess and transfer process several years prior to our study

through the collective bargaining process, and it was now much less of a constraint for these two districts.

Finances. Many of the strategies that administrators pursued, or wanted to pursue, required money. Our sense from interviewing the administrators was that they were attempting to implement their coping strategies with little in the way of additional financial resources. Indeed, when asked what changes might improve their ability to recruit and retain high quality math teachers, many administrators talked about the need for additional resources in the form of money for incentives but also in the form of additional recruiters and other HR staff or higher advertising budgets. Lack of money limited the strategies they felt they could effectively pursue.

Capacity

Capacity often influences an organization's ability to carry out certain actions successfully. Districts varied in terms of existing capacity, and this also appeared to influence which strategies administrators pursued. Existing capacity, which was the result of past investments in material, human, intellectual, or organizational resources, affected whether district strategies were incremental in nature or farther reaching.

Some districts, which had not invested in new capacity, often adopted strategies that involved adding on to existing practices or that did not require additional capacity. They attended a few extra job fairs, visited a few more universities in search of candidates, changed their recruitment messages, or offered math candidates a few additional steps on the salary schedules. Other districts, in contrast, had invested in capacity that allowed them to do new things or were willing to pursue new initiatives that required the development of new capacity.

Information Technology. Ellington and Callahan's investments in technology allowed them to improve the processing of applicants, their ability to visualize their applicant pool, and to

get information to principals with openings. These districts went further than simply buying hardware and software, however. They also reengineered their hiring processes. Ellington's incorporation of Information Technology occurred in the context of a long process of decentralizing its hiring process. The introduction of a better HR information system complemented these organizational changes and provided principals with a better tool for identifying candidates for their openings. Candidates who in previous years were lost in the shuffle were now more likely to get steered to schools with appropriate openings. In contrast, information technology allowed Callahan to recentralize part of the hiring process and relieve busy principals from the burdens of recruiting and performing the initial screening of candidates. They still played the major role in the hiring decisions, but were no longer left to fend for themselves. As a much smaller district than Ellington, Callahan was able to benefit from some of the advantages of centralizing the initial step of the hiring process without incurring some of the disadvantages. They reduced duplication of effort and increased consistency in how candidates were treated, while still giving principals the authority to hire candidates that they felt were the best fit for their schools.

The experience of Hampton, however, suggests that simply investing in technology is not enough if administrators do not also change organizational processes to take advantage of the new technology. Although Hampton also invested in an online application system, many principals still complained about lost paperwork, slow processing of job offers, patronage, and difficulty communicating with the central HR process regarding the candidacy of applicants. Apparently, the central HR office did not have sufficient capacity to put the new technology to productive use.

Grow-Your-Own Strategies. Other strategies for coping with the math staffing challenge also required the existence of capacity or the development of new capacity. For instance, starting a district-run alternative certification program, as Ellington did, constituted a system change since it gave the district the authority to certify new teachers. This strategy has had significant capacity implications, for its success rested on the district's capacity to deliver coursework, support teachers in field placements, and provide feedback and coaching. The district needed staff who had the skills and knowledge to be instructors, mentor teachers, supervisors, etc., and who could work together to create a cohesive training experience. This was also true for other districts, such as Armstrong, Gillespie, and Hampton, that sought to provide training in mathematics and math pedagogy to current middle school teachers to enable them to meet the Highly Qualified Teacher provisions of *No Child Left Behind* and remain in their positions.

On a related note, some districts had other longer-term grow-your-own strategies such as providing sabbaticals with tuition coverage for teachers to get certified in a shortage area subjects, or using high school teacher clubs to encourage their own high school students to become teachers and return to teach in the district. These strategies often relied less on the district's internal capacity to train teachers and more on providing incentives to individuals to seek training from external organizations (i.e., university training programs).

School-Based Support. At the level of the individual school, the capacity of principals, other building administrators, and veteran teachers to support new teachers influenced districts' ability to deliver on what they had promised new teachers during the recruitment and hiring process. It is one thing to promise support and another to actually deliver in a way that helps new teachers become more effective, increases their satisfaction on the job, and reduces their turnover. Armstrong and Dorsey stood out as districts that offered comprehensive, school-based

support for new teachers. Other districts certainly offered support to new teachers, but their efforts often seemed more fragmented or uneven. For instance, in Joplin, there was said to be a large variation in the teacher turnover rates among schools in the district, with this variation attributed to differences in school climate, principal leadership, and support structures.

Capacity and Compromises. Finally, capacity also influenced how some administrators made compromises when they had to hire less than ideal candidates. In weighing trade-offs and deciding which teacher characteristics or skills to prioritize and which to deemphasize, some administrators considered what characteristics they felt their district and schools could most easily compensate for by offering training or support. For instance, would they be better off hiring teachers with stronger subject matter knowledge and weaker classroom management skills because they felt their school principals were strong in helping teachers promote student engagement and maintain discipline, or would they be better off hiring candidates who had demonstrated an ability to relate and engage children but had somewhat weaker subject matter knowledge, because their administration had the capacity to supplement knowledge of math and math pedagogy through training and mentoring?

CONCLUSIONS

The districts we studied were confronted with the challenge of filling their mathematics positions in the context of both an existing shortage of qualified math teachers as well as new federal mandates stipulating higher minimum qualifications, which further reduced the supply of hirable teachers. In the midst of this difficult situation, districts and administrators adopted a number of different strategies for coping. In each of the eight districts, we found practices and reforms that held promise, and we heard about some recent improvements that helped make the situation better than it otherwise would have been.

As a group, the districts adopted a range of strategies that attempted to either increase the supply of math candidates or reduce their demand for them by limiting turnover. Certain districts also attempted to make organizational changes or process improvements that would enhance their ability to identify qualified applicants, steer them to schools for which they would be a good match, and hire them quickly before other districts snapped them up. Sometimes, however, when faced with the need to fill a position quickly, administrators simply had to compromise and hire less than satisfactory candidates.

Districts did vary, however, in the particular mix of strategies that administrators pursued. Their strategies appeared to reflect an interaction between three factors: (1) the particular nature of the challenge facing their district, (2) the constraints (both real and perceived) that administrators faced, and (3) the organizational capacity that the districts and schools had or were able to build. It is not surprising that because the individual context of each district was different, administrators focused on different aspects of the staffing challenge or approached the challenge in somewhat different ways. Administrators faced somewhat different challenges and constraints, and they worked in districts that varied in terms of organizational capacity and financial resources.

An important finding of this study was that the district personnel were very aware of the challenge of attracting and retaining high quality math teachers, took it very seriously, and seemed to be working diligently to develop policies and practices that would help them meet this challenge. Indeed, despite the challenges that they faced in hiring math teachers, most of the districts succeeded in filling virtually all of their openings with “highly qualified” math teachers. This finding was interesting and surprising. However, some of these teachers were hired with the expectation that, although they were “qualified” according to *NCLB*, they might not be able to

succeed as urban math teachers. Administrators were well aware that "highly qualified" did not necessarily mean high quality. Thus, although they were meeting the mandates of NCLB, they were still struggling with getting mathematics teachers with the full set of skills, knowledge, and dispositions required to teach successfully in an urban setting, and in some ways, the mandates of *NCLB* were making this task more difficult by limiting their flexibility.

Our findings suggest that organizational decisions do matter. Although districts and schools are certainly affected by broader economic and demographic factors that are very powerful, what we have found suggests that the decisions and actions taken by district and school-based administrators can have an effect on the recruitment and retention of math teachers. The administrators we interviewed had considerable agency. How they viewed and understood their challenge, and the policy instruments they employed, did have an effect on their districts' ability to meet the challenge of staffing their schools with high quality mathematics teachers.

The findings of our study also confirm some of the limitations of utilizing mandates and inducements that McDonnell and Elmore (1987) identified in their classic article. *NCLB's* highly qualified teacher mandates sought to promote uniformity by forcing districts to staff their schools with teachers who fit certain legislated criteria. The implicit goal was to eliminate the discretion that school administrators had in making staffing decisions—discretion that policymakers presumed too many were abusing. Our findings suggest, though, that the mandates also reduced administrators' ability to adapt to their varied circumstances and imposed heavy compliance costs on some districts. For instance, the mandates forced several districts to expend scarce resources simply to keep experienced grade 6-8 mathematics teachers in their current teaching positions. In addition, whenever veteran middle school math teachers decided not to participate in this extra training but instead requested reassignment to non-mathematics positions, districts

then had to devote resources to recruiting and hiring replacements. Overall, this increased training in the teaching of mathematics likely had very salutary effects, especially for those middle school teachers who were indeed under-prepared. However, it was not cost free. The districts had to hire instructors or pay tuition to enable these teachers to work toward secondary mathematics certification. Because these districts did not receive additional funding to help meet these federal mandates, it is worth considering the opportunity costs (both in terms of money and teachers' time) associated with these compliance activities, especially for veteran middle school math teachers who might have been effective in the classroom but simply did not meet the NCLB criteria for being highly qualified.

The experiences of the districts in our study also illustrated the difficulty of utilizing inducements, particularly in the context of traditional single salary schedule and collective bargaining. One challenge that districts faced was offering incentives that were large enough to be meaningful and to actually affect candidates' decisions and behavior. None of the districts in our study offered an inducement for math teachers that came close to the 20-50% wage premium suggested by Hanushek et al (2001). Moreover, all of the administrators believed that there were simply not enough math majors out there to fill all the positions that need to be filled, implying that inducements would have limited effects (at least in the short term) because adequate capacity did not currently exist out in the labor market to be bought.

What is needed, then, is a greater focus on capacity building. The strategies that seemed to be bearing the most fruit involved: investing in the training and preparation of high quality mathematics teachers, investing in the capacity of central human resource offices to manage the recruitment and hiring process more effectively (using information technology and/or process improvements, and investing in staff), and improving the capacity of schools to provide

comprehensive, on-the-job support to newly hired teachers to ensure their effectiveness and retention.

This is not to say that incentives in the form of salaries are unimportant. Indeed, if there are major salary discrepancies between a district and its neighbors, all of its capacity-building efforts may be for naught. In our study, we had districts that were trying valiantly to improve the hiring process and offer as much support as possible to new teachers and that still could not overcome major salary discrepancies and attract a quality pool of applicants. So, incentives do matter and the absence of a competitive salary can seriously disadvantage an urban district.

On the other hand, focusing solely on incentives is problematic. In deciding which initiatives to invest in, administrators and policymakers need to be conscious of the pitfalls that McDonnell and Elmore warn about. Incentives are often the easiest policies to sell, since they are easy to understand. Yet, our findings suggest the dangers of failing to invest in capacity. Although the payoff of capacity building is often difficult to measure and takes time to be realized, it is essential for improving districts' ability to recruit and retain high quality teachers.

A clear implication of our findings and our analysis, therefore, is that policymakers ought to utilize a variety of policy instruments to help urban districts meet the complex challenge of recruiting and retaining high quality mathematics teachers. Although we did not ask administrators directly about state and federal policy, their experiences and the nature of the challenges they described suggest that the following policies are worth considering:

- Providing financial incentives to encourage math majors to enter teaching – The overall applicant pool is simply too small, which leads to intense competition that disadvantages urban school districts. Scarcity of applicants can also lead to micro-political activity within districts, as school principals compete for the best candidates. In the long term, increasing this pipeline would likely make the challenge more manageable.

- Reforming the single-salary schedule to offer differentiated pay to teachers in shortage subjects such as mathematics, as well as incentives to take positions in urban, high-poverty schools. At a certain point, the pay disadvantage that urban districts have can be almost insurmountable. Administrators in our study lacked the resources or the flexibility to offer sufficient inducements to high quality candidates.
- Providing mechanisms that reduce the impact of state budget delays on districts' ability to hire.
- Providing funds that help districts build capacity in their human resource systems—e.g., money for better information systems and additional staff
- Dedicating resources to help districts build capacity in their support systems for new teachers—e.g., for strengthening induction and support programs for new teachers.

Many of these policies will clearly be costly. Some of these costs could be covered by reallocating current resources or spending current resources more wisely. However, it is also likely that additional resources will be necessary, especially if policymakers seek to reform the teacher pay structure. If we are serious about ensuring that every child is taught by a capable and effective mathematics teacher, we must make the necessary investments.

REFERENCES

American Association for Employment in Education. (2005). Educator supply and demand in the United States. Columbus, OH: American Association for Employment in Education.

Ballou, D., & Podgursky, M. (1997). *Teacher pay and teacher quality*. Kalamazoo, MI: W. E. Upjohn Institute for Employment Research.

Boyd, D. Lankford, H., Loeb, S., & Wyckoff J. (2005). The draw of home: How teachers' preferences for proximity disadvantage urban schools. *Journal of Policy Analysis and Management*, 24 (1), 113-132.

Glenn Commission (2000). Before it's too late: A report to the nation from The National Commission on Mathematics and Science Teaching for the 21st Century. Jessup, MD: U.S. Department of Education.

Harris, D. N., Rutledge, S. A., Ingle, W. K., & Thompson, C. C. (2006). Mix and match: What principals look for when hiring teachers and implications for teacher quality policies. Manuscript submitted for publication.

Hanushek, E. A., Kain, J. F., & Rivkin, S. G. (2001). *Why public schools lose teachers* (Working Paper 8599). Cambridge, MA: National Bureau of Economic Research.

Ingersoll, R. M. (2001). Teacher turnover and teacher shortages: An organizational analysis. *American Educational Research Journal, 38*(3), 499-534.

Johnson, S. M. (1986). Incentives for teachers: What motivates, what matters. *Educational Administration Quarterly*, *22*(3), 54-79.

Johnson, S. M., & Birkeland, S. E. (2003). Pursuing a "sense of success": New teachers explain their career decisions. *American Educational Research Journal, 40*(3), 581-617.

Johnson, S. M., & The Project on the Next Generation of Teachers. (2004). *Finders and keepers: Helping new teachers survive and thrive in our schools*. San Francisco: Jossey-Bass.

Lankford, H., Loeb, S., Wyckoff, J. (2002). Teacher sorting and the plight of urban schools: A descriptive analysis. *Educational Evaluation and Policy Analysis* 24(1), 37-62.

Levin, J., & Quinn, M. (2003). *Missed opportunities: How we keep high quality teachers out of urban classrooms*. Washington, DC: New Teacher Project.

Liu, E. (2004). *Information-rich, information-poor: New teachers' experiences of hiring in four states.* Unpublished doctoral dissertation, Harvard University.

Liu, E. (2005, April). Hiring, job satisfaction, and the fit between new teachers and their schools. Paper presented at the annual meeting of the American Educational Research Association, Montreal.

Liu, E. & Johnson, S. M. (2006). New teachers' experiences of hiring: Late, rushed, and information-poor. *Educational Administration Quarterly,* 42(3), 324-360.

Liu, E., Johnson, S. M., & Peske, H. G. (2004). New teachers and the Massachusetts Signing Bonus Program: The limits of inducements. *Educational Evaluation and Policy Analysis*, 26(3), 217-236.

Liu, E., Rosenstein, J. G., Swan, A. E., & Khalil, D. (*2008*). When districts encounter teacher shortages: The challenges of recruiting and retaining mathematics teachers in urban districts. *Leadership and Policy in Schools, 7(3),* 296-323.

Lortie, D. C. (1975). *Schoolteacher: A sociological study*. Chicago: University of Chicago Press.

McDonnell, L. M., & Elmore, R. F. (1987). Getting the job done: Alternative policy instruments. *Educational Evaluation and Policy Analysis, 9*(2), 133-152.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook.* Thousand Oaks, CA: Sage Publications.

National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. (2007). *Rising above the gathering storm: Energizing and employing American for a brighter economic future*. Washington, DC: National Academies Press.

Neild, R. C., Useem, E., Travers, E. F., & Lesnick, J. (2003). *Once & for all: Placing a highly qualified teacher in every Philadelphia classroom*. Philadelphia, PA: Research for Action.

Nye, B., Konstantopoulos, S., & Hedges, L. V. (2004). How large are teacher effects? *Educational Evaluation and Policy Analysis, 26(3), 237-257.*

Odden, A., & Kelley, C. (1997). *Paying teachers for what they know and do: New and smarter compensation strategies*. Thousand Oaks: Corwin Press.

Peske, H. G., & Haycock, K. (2006). *Teaching inequality: How poor and minority students are shortchanged on teacher quality*. Washington, DC: The Education Trust.

Rivkin, S., Hanushek, E., & Kain, J. (2005). Teachers, schools, and academic achievement. *Econometrica, 73(2), 417-458.*

Rockoff, J. (2004). The impact of individual teachers on student achievement: Evidence from panel data. *American Economic Review, 94(2), 247-252.*

Sanders, W. L., & Rivers, J. C. (1996). *Research project report: Cumulative and residual effects of teachers on future student achievement.* University of Tennessee.

Smith, T., & Ingersoll, R. M. (2004). What are the effects of induction and mentoring on beginning teacher turnover? *American Educational Research Journal, 41(3), 681-714.*

Thomas B. Fordham Foundation. (1999). *The teachers we need and how to get more of them: A manifesto*. Washington, D. C.: The Thomas B. Fordham Foundation.