

## ABSTRACT

Title of Document: **THREE ESSAYS ON THE ROLE OF  
TEACHER WORKING CONDITIONS IN  
SHAPING HUMAN CAPITAL**

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In recent years, education policy has increasingly focused on improving human capital as a strategy for school improvement. Many recent efforts to enhance the stock of human capital in schools have focused on holding individual teachers accountable for student outcomes, with little regard to the role of teachers' working conditions in shaping human capital. Yet prior research by labor economists, organizational sociologists, and educational researchers indicates that working conditions can influence teachers' choices about where to work, and some evidence suggests that aspects of the school environment may foster or inhibit effective teaching. In this dissertation I report the results of three studies that explore the relationship between working conditions in schools and three different expressions of human capital. I explore similar notions of working conditions across these studies to peruse how these working conditions relate to both educational opportunities, such as student access to quality high school mathematics teachers,

and educational outcomes, including elementary school teachers' effectiveness and novice teachers' gains in effectiveness.

In the first study, I use multilevel logistic regression to explore students' access to quality teachers based on a nationally representative sample of ninth grade mathematics students. I find that ninth graders in schools with greater collegial support are more likely to have quality mathematics teachers. In the second study, I explore data on teachers of fourth and fifth grade students nested in schools in a large urban district and employ a two-level hierarchical model to examine the relationship between working conditions and teacher effectiveness. Average teacher effectiveness is higher, on average, in schools with strong data use and strategic decision-making and in which teachers perceive high level of collegial support. In the final study, I use the same data but limit the sample to early career teachers to examine how working conditions facilitate or impede gains in early career teachers' effectiveness. I find that novice teachers have greater gains in effectiveness in English language arts in schools that are perceived by teachers as having strong learning communities. Novice teachers' gains in effectiveness in mathematics are greater in schools with greater collegial support and data use.

THREE ESSAYS ON THE ROLE OF TEACHER WORKING CONDITIONS  
IN SHAPING HUMAN CAPITAL

By

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## Preface

In each of the three studies in this dissertation, I examine how different expressions of human capital—namely, student access to quality teachers, teacher effectiveness, and changes in teacher productivity over time among novice teachers—are influenced by organizational and workplace factors. Thus, one theme common to all three papers is the notion that working conditions may influence the availability and productivity of teachers’ human capital. I explore similar notions of working conditions across these studies to peruse how these working conditions relate to both educational opportunities, such as student access to quality high school mathematics teachers, and educational outcomes, including elementary school teachers’ effectiveness and novice teachers’ gains in effectiveness.

In the first study, I use a nationally representative sample to explore disparities in ninth grade mathematics students’ access to quality mathematics teachers. I analyze the extent to which students have differential access to quality teachers within schools as a function of the student’s prior academic achievement, as well as the extent to which students have differential access to quality teachers between schools as a function of school characteristics (such as average socioeconomic status of students) and working conditions (e.g. teachers’ perceptions of the quality of school leadership). I also examine the proportion of the variation in students’ access to quality teachers in their ninth grade mathematics classes that can be explained by working conditions.

In contrast to the first study, which focuses on student access to teachers with specific qualifications, the second and third studies focus on teacher effectiveness as measured by average student test-score gains, an approach often referred to in the literature as “value-added”

(Baker et al., 2010; Corcoran, 2010; Glazerman, Loeb, et al., 2010). Recent reforms have expanded the focus of accountability policies to hold teachers as well as schools accountable for student achievement as measured by standardized tests. Estimates of teachers' value-added are increasingly used as a teacher evaluation metric and the basis for consequential decisions, such as whether to grant teachers tenure. Some researchers have questioned whether we should hold teachers responsible for student progress when many factors affecting this progress are outside the control of teachers (Lissitz, 2005; Rothstein, 2010). While value-added estimates often include controls for students' socioeconomic status and similar background variables to mitigate this issue, these controls are proxies that likely fail to capture all the aspects of the home and neighborhood environment that may influence student achievement gains. In addition, other factors besides students' backgrounds might also influence student gains. For example, many students learn from multiple educators, such as paraprofessionals and special educators providing additional instructional support, in addition to their teacher of record (Valli, Croninger, & Walters, 2007).

More specifically, in the second study, I draw on data from New York City (NYC) public elementary schools to explore the extent to which teacher effectiveness is related to school characteristics and working conditions. I obtained both teacher perception data (from school surveys) and data from external reviews of how well the school is organized to support student achievement. I used these datasets to create constructs intended to capture aspects of teachers' working conditions hypothesized to influence effectiveness, such as the extent to which teachers collaborate, the quality of school leadership, and school staff use of data. I then explore which, if any, aspects of the teachers' working environments predict greater average effectiveness of

teachers. I also analyze the proportion of variation in teachers' value-added scores that is explained by working conditions.

While the third study also draws from the NYC database, it focuses on novice teachers and their growth in productivity in the first few years of teaching. I explore novice teachers' effectiveness in their first year of teaching as well as how much they gain in effectiveness over the course of a year. In this study, I again draw from both teacher perceptions and data from external reviews of how well the school is organized to support student achievement. The constructs based on these sources of data are used to predict novice teachers' gains in effectiveness.

As I discuss in the concluding chapter of my dissertation, the three empirical studies presented in this dissertation shed light on how school working conditions relate to three policy-relevant facets of human capital. Disparities in working conditions that favor schools serving students of higher socioeconomic status may exacerbate inequality in educational opportunity by leaving lower-income students with less access to quality and effective teachers. Such disparities may also make it more difficult for teachers to continuously learn and improve their performance. Given that novice teachers learn on the job, beginning teachers may be particularly affected by disparities in working conditions.

# Dedication

In memory of Sharon Kleiman,  
an extraordinary school leader whose  
enthusiasm, high standards and dedication  
to her students continue to inspire.

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## Chapter 1: Shaping Human Capital

Recent empirical evidence supports the intuitive notion that teachers are the most important resource that schools have to produce desired outcomes (Rivkin, Hanushek, & Kain, 2005; Wright, Horn & Sanders, 1997). Furthermore, empirical evidence indicates that teachers' effects on students, as captured by performance on standardized assessments in core academic subject areas, vary greatly (Nye, Konstantopoulos, & Hedges, 2004; Rivkin, Hanushek, & Kain, 2005). Performance on such assessments is an indicator of students' literacy and numeracy skills, and improving such skills prior to when students enter the workforce has dramatic implications for the future of the individual students (Hanushek, Jamison, Jamison, & Woessmann, 2008). Given that teachers have a direct impact on student achievement and that some teachers are better at promoting student achievement than others, policies aimed at ensuring the equitable distribution of quality teachers and at increasing teacher effectiveness appear to be promising avenues for enhancing student outcomes and educational equity.

### **The Policy Context: Efforts to Enhance Human Capital**

Policymakers have long exhibited an interest in addressing school performance via the development of human capital, a form of capital "created by changes in person that bring about skills and capabilities that make them able to act in new ways" (Coleman, 1988). Policy approaches to enhance the stock of human capital in schools have focused on ensuring some minimal level of skills (a) through requirements for entering the profession such as certification or teacher examinations and (b) improving human capital through a variety of training mechanisms such as professional development and mentoring to enhance teachers' skills.

The No Child Left Behind Act (NCLB), signed into law in 2002, establishes a definition of a ‘highly qualified’ teacher<sup>1</sup> and requires states to describe steps taken to ensure that students in schools receiving Title I funds have access to highly qualified teachers. The requirement is meant to result in more students having access to teachers with the specified credentials. However, this approach will only increase students’ access to higher quality teachers if those credentials are predictive of teacher quality. Much of the extant literature suggests that teacher performance may be independent of the very characteristics that policymakers use to identify a teacher as “highly qualified.” While secondary mathematics teachers’ certification and subject matter knowledge does appear to be related to student achievement, most conventional measures of teacher qualifications such as highest degree earned do not appear to be strongly related to student achievement (Goe, 2007; Rice, 2003). Thus, some policymakers and education leaders have critiqued the highly qualified teacher provisions as an inefficient mechanism for improving educational productivity.

In contrast to NCLB’s focus on teacher qualifications, the 2009 federal initiative Race to the Top (RTTT) makes use of competitive grants to encourage states and districts to focus on teacher performance. Specifically, the initiative encourages states and districts to improve the teacher workforce by using data on teacher performance to guide decisions related to teacher compensation, development, promotion, and retention. RTTT requires grantees to include multiple measures of teacher effectiveness. RTTT also specifies that teacher effectiveness is to be evaluated “in significant part” by student growth, which is defined as “the change in student achievement...for an individual student between two or more points in time” (USDOE, 2010, p.

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<sup>1</sup> Generally speaking, a highly qualified teacher is one with full State certification, a bachelor’s degree, and demonstrated subject matter knowledge.

19500). In essence, RTTT requires its grantees to take average student test-score gains into account when measuring teacher effectiveness, an approach often referred to in the literature as “value-added” (Baker et al., 2010; Corcoran, 2010; Glazerman, Loeb, et al., 2010).

Identifying the theory of action behind policy initiatives can facilitate inspection of the assumptions that must be met for the policy to achieve its aims (Malen, Croninger, Muncey, & Redmond-Jones, 2002). Both NCLB’s highly qualified teacher provisions and RTTT suggest an underlying theory of action whereby improving human capital will yield greater student achievement. The assumption underlying the highly qualified teacher provisions of NCLB is that qualified teachers will be more capable of improving student achievement, yet research shows teacher qualifications to be weakly linked to student outcomes (Goe, 2007; Rice, 2003). In contrast, RTTT encourages grantees to make human capital decisions around tenure, promotion, and dismissal based on more direct measures of teacher effectiveness, including classroom observations and measures of student growth.

While RTTT promotes the use of measures of teacher effectiveness in making high-stakes human capital decisions including the dismissal of ineffective teachers, grant points are also awarded based on whether the plan includes various forms of educator support. Specifically, applicants may be awarded grant points based on the extent to which the state has a high-quality plan for participating districts to provide “effective, data-informed professional development, coaching, induction, and common planning and collaboration time to teachers” (USDOE, 2009a, p. 10). Thus, language in the executive summary of the policy suggests a second theory of action, one in which educator effectiveness can be enhanced by the support systems available to the educators. Furthermore, grant points are awarded on the basis of removing ineffective educators “after they have had ample opportunities to improve” (USDOE,

2009a, p. 9). This provision indicates that policymakers view educator effectiveness as a dynamic rather than static characteristic of educators, and that certain opportunities may facilitate growth in effectiveness.

### **Theoretical Frameworks**

Much current policy focuses on individual teachers but underemphasizes the potentially moderating effect of the working environment. Some research has also focused on the individual teacher and on the potential impact of policies that focus on individual teachers. Other researchers, however, have explored the social organization of teaching and learning, emphasizing that teachers work collaboratively to promote student learning.

The three studies build on prior work conducted in the framework of school effects research, which explores how aspects of schools influence educational outcomes. School effects research recognizes that learning occurs in a complex system in which students are nested within classrooms, which are, in turn, nested within schools (Raudenbush & Bryk, 2002). Many researchers in this tradition hypothesize that student achievement can be measured at different levels of the education system (e.g., the student, the classroom, and the school). For instance, student outcomes may vary within a particular school as a result of student- and family-level characteristics (e.g., prior achievement or family socioeconomic status), yet they also may vary systematically across classrooms or schools as a result of class or school characteristics (e.g., average achievement of peers within a classroom or average socioeconomic status of peers in schools).

Bidwell and Karsada (1980) argue that schooling, which they describe as the process through which instruction occurs, is conditioned by the social organization of the environment in

which learning occurs. For that reason, they argue that theories of school effects must show how the organization of schools affects schooling. Under this view, “organizational attributes of schools may affect the resources that their instructional units provide” (Bidwell & Karsada, 1980, p. 403). In this dissertation, I explore how the social organization of schools affects the resource of human capital, in terms of students’ access to quality teachers in the first study, and in terms of teachers’ effectiveness in the second and third studies.

The studies that make up this dissertation also build on prior work conducted within the framework of educational productivity. Since the *Equality of Educational Opportunity*, which was the first study to apply the economic concept of a production function to the field of education, a number of researchers have conducted studies in which they relate inputs affecting a student’s learning to measured output (Hanushek, 1979). In this dissertation, I apply an educational productivity framework with working conditions as the primary inputs of interest, and measures of teacher quality, effectiveness, and gains in effectiveness as the outputs.

*Working Conditions.* *Working conditions* as employed in this dissertation is a very broad term, drawing on past research that has explored how numerous aspects of school environments influence teachers’ attitudes and behaviors. Some researchers have examined physical aspects of the working environment, such as material resources and facilities (Loeb, Darling-Hammond, & Luczak, 2005; Ladd, 2011; Johnson Kraft, & Papay, 2011). Others have studied the qualifications and effectiveness of one’s colleagues as aspects of teachers’ working conditions that might influence teacher effectiveness via peer learning (Croninger, Rice, Rathbun, & Nishio, 2007; Jackson & Bruegmann, 2009). Thus, the term *working conditions* encompasses physical capital in the form of material resources as well as access to human capital (i.e. quality of one’s

colleagues). In addition, the assumptions that teachers share about appropriate attitudes and behaviors, or the normative culture, constitutes a critical aspect of working conditions (Rosenholtz, 1989). These shared assumptions are among the school working conditions that might be thought of as elements of social capital and informational resources. I describe what is meant by these terms in more detail below.

Many relevant aspects of the school context might be construed as types of social capital, or measures of the social relationships with administrators and colleagues that function as resources for teachers within the school. Forms of social capital include the obligations, expectations, and trustworthiness of social structures; information channels; and norms and effective sanctions (Coleman, 1988). Coleman (1988) states that social capital “constitutes a particular kind of resource available to an actor” and that it is defined by its function—situated in the structure of relations between actors, social capital makes “possible the achievement of certain ends that in its absence would not be possible” (p. S98).

A considerable body of management research and organizational theory has focused on aspects of social capital that might benefit organizations (such as schools) in which productivity is influenced by information sharing among employees (Peters & Waterman, 1982; Ouchi, 1981). For example, Ouchi’s (1981) Theory Z, which borrows ideas from Japanese company culture aimed at increasing productivity while reducing absenteeism and staff turnover, postulates that workers seek positive relationships based on cooperation with colleagues and employers, and that such relationships foster discipline and moral commitment to the work. Theory Z underscores the need for staff development and training and presumes that to maximize productivity, management must support employees.

Examples of factors of social capital that are salient to teachers' satisfaction and professional growth include school leadership (c.f. Johnson, Berg, & Donaldson, 2005; Ladd, 2011; Boyd et al., 2011), teacher collaboration and shared goals (Rosenholtz, 1989), relational trust (Bryk & Schneider, 2002), and school personnel's shared meanings and patterns of behavior (Rinke & Valli, 2010). Measures of social capital constitute "an aid in accounting for different outcomes at the level of individual actors" (Rice & Croninger, 2005, p. S101). For the purpose of these studies, I focus on the relationships and interactions among teachers and between teachers and school administrators as forms of social capital that may shape teacher distribution and effectiveness. Borrowing from Weick's (1976) "coupling imagery," I attempt to capture the degree of coupling between teachers and between teachers and administrators. Tighter couplings may provide opportunities for the sharing of interpersonal resources.

Informational resources include opportunities for professional collaboration and support for use of data to improve instruction. Researchers have explored whether professional development influences teachers' career decisions or improves student achievement (Ladd, 2011; Yoon et al., 2007). While the research on the use of data and formative assessment to improve instruction is still in its infancy, in theory, data analysis and formative assessments might be used as informational resources to improve the quality of learning activities (Black & Wiliam, 2006). As Weick (1976) notes, "in educational organizations the expected feedback linkage from outcome back to inputs is often nonexistent" (p. 5). Organizations that make use of available data might be thought of as having tighter couplings between outcomes and inputs (teachers), which might enable teachers to be more adept in determining which instructional strategies they undertake and which topics they reiterate—assuming that teachers have some decision-making authority. The extent to which school norms encourage and support teachers' use of data to

inform instruction may facilitate a more efficient use of classroom time, and thus influence teachers' effectiveness.

Much of the previous literature on working conditions explores teacher satisfaction or retention as outcomes. Working conditions that predict retention are good candidates for inclusion in the first of the three studies, which explores students' access to quality teachers, since schools' ability to retain teachers is directly related to student access to teachers. However, different sets of working conditions may be more relevant for the second and third studies. Organizational theory and research on the human relations model suggest that satisfied employees are not necessarily more productive employees (Perrow, 1986). Thus, the aspects of the school environment that are related to teacher satisfaction are not necessarily the same factors that influence teacher effectiveness. Furthermore, novice teachers' effectiveness may be influenced by a particular subset of the working conditions hypothesized to be related to teacher effectiveness. For example, Brunetti (2001) noted a pattern of change over time: teachers collaborated more with colleagues as younger faculty; as older faculty members, teachers placed less value on collegial activities. Reflecting theory and prior research, each of the three studies includes a slightly different mix of working conditions (listed in Appendix A).

*School Context.* In contrast to working conditions, some of which are shaped by teachers and school leaders, school context encompasses characteristics of schools that are outside the control of school staff. Raudenbush and Willms (1995) describe school context as "school-level factors that are exogenous to the practices of the school's administrators and teachers" such as social and economic characteristics of the neighborhood and student demographics (p. 310). The extent to which families have the time and resources to be engaged in and supportive of their children's schooling is an aspect of school context. In this dissertation, I used aggregates of

student characteristics such as the proportion of students eligible for free and reduced meals as proxies for school context.

In all three studies, I incorporate measures of both working conditions and school context. Whereas teachers' working conditions might be thought of as malleable and therefore policy-relevant facets of the school environment, school context is less under the control of policymakers. In the first study, I model school context as well as working conditions largely because school context may be correlated with working conditions, and including both in the model is an effort to isolate facets of the school that might be addressed by policy from those features of a school that are less malleable. In the second and third study, I include school context due to concerns that teacher measures of teacher effectiveness may, in part, be capturing the contextual effects of attending a school serving students with a particular set of demographic characteristics.

Additionally, I include interactions between school context and working conditions to explore whether teachers are more strongly influenced by working conditions in some environments than in others—that is, to assess whether school context moderated the relationship between working conditions and the outcomes. It is possible, for example, that schools with favorable contexts have an easier time attracting and retaining effective teachers and that teacher effectiveness in such schools is relatively unaffected by working conditions, whereas in schools with more challenging contexts that struggle to attract and retain effective teachers, the effectiveness of teachers is more contingent on working conditions. Another possibility is that the impact of one working condition is contingent upon other working conditions. For example, school practices around using data may be ineffectual in schools with weak leadership, but have a positive relationship with teacher effectiveness in schools with strong leadership.

### **Purpose of the Dissertation**

This dissertation will build on and extend prior research by using a large urban dataset and a nationally representative dataset to explore how workplace factors shape teacher distribution, effectiveness, and changes in productivity in the early years of teaching. These three studies build on one another in that I use similar notions of working conditions to first explore an aspect of educational opportunity, in the form of student access to quality teachers, then educational outcomes, including teacher effectiveness and novice teachers' changes in effectiveness.

Whereas past research has demonstrated in separate studies that teachers may be inequitably distributed both within schools (Loeb, Kalogrides, & Béteille, 2011) and across schools (Guarino, Brown, & Wyse, 2011; Hanushek, Rivkin, & Kain, 2004; Lankford, Loeb, & Wyckoff, 2002), the proposed study examines differences in students' access to quality teachers within and across schools simultaneously. It also seeks to extend the generalizability of prior work regarding the workplace factors associated with differential distribution of teachers across schools (Boyd et al., 2011; Horng, 2009; Ladd, 2011).

While teachers are known to vary in effectiveness within schools as well as across schools, certain aspects of a school's working conditions may facilitate or impede teachers' ability to promote student achievement and may explain some of the variation in teacher effectiveness across schools. The work of Johnson, Kraft, and Papay (2011) and Ladd (2009) suggest that certain aspects of working conditions may be related to student achievement. While it is possible that certain working conditions directly impact student achievement, in this dissertation I explore whether working conditions facilitate or impede student achievement via

the effect working conditions have on teachers. Thus, a second purpose of this work is to identify those aspects of working conditions that are related to the average value-added scores of teachers within schools.

In addition, research suggests that the relationship between teacher experience and effectiveness varies across schools (Sass, Hannaway, Xu, Figlio, & Feng 2010). Loeb, Kalogrides, and Béteille (2011) provide evidence that schools themselves play a role in how much teachers gain from their experience. The third purpose of this work is to identify dimensions of the school context and school working conditions that are associated with novice teachers' changes in effectiveness. If positive working conditions are attractive to quality or effective teachers, the relationships between working conditions and teacher quality or effectiveness may be explained by self-selection. In the third study, I look at changes in effectiveness in the third study in part to address the possibility that self-selection is responsible for the relationships observed in the first two studies.

*Research Questions.* I examine whether specific workplace factors—such as school leadership and collegial support among teachers—are associated with students' access to quality teachers, teacher effectiveness, and novice teachers' changes in productivity during the first few years of teaching. The research questions explore the conditions under which students have equitable access to quality teachers, and the conditions under which teachers are most effective and able to improve over time. I address the following research questions by conducting three related but distinct secondary analyses of policy-relevant datasets:

Study 1: Are students in schools with less favorable contexts (e.g. schools serving predominantly lower-achieving students of lower socioeconomic status) less likely to have quality teachers relative to students in schools serving more advantaged

populations? Do working conditions influence students' likelihood of having a quality teacher?

Study 2: Does average teacher effectiveness vary across schools? Are school supports for teachers such as perceived support from administrators and professional learning opportunities related to teacher effectiveness?

Study 3: Do new teachers experience changes in productivity during the early years of teaching? What aspects of the teachers' working conditions enhance or inhibit growth in productivity for beginning teachers?

*Importance of the Studies.* As state and local education agencies implement federal policies targeted at improving student outcomes via human capital mechanisms, they need empirically-based research on the three outcomes in this dissertation: students' access to quality teachers, teacher effectiveness, and novice teachers' changes in effectiveness over time. The three studies that make up this dissertation concentrate on how working conditions relate to each of these measures of human capital. In light of resource constraints, this knowledge can help education leaders make strategic choices about which working conditions to target for improvement. In addition, districts might want to take into account variation in teachers' workplace conditions or learning opportunities when making human capital decisions that are based in part on teachers' impact on student achievement gains. Finally, each study also seeks to explore more fully methods for better understanding how working conditions influence access to quality teachers, teacher effectiveness, and change in effectiveness during the early years of a teachers' career. By assessing existing measures and methodological strategies, these studies identify some of the challenges to and opportunities for understanding how working conditions may influence policies that seek to shape human capital.

## Chapter 2: Student Access to Quality High School Mathematics Teachers: A Multilevel Analysis

### Introduction

Decades of research shows that disadvantaged students tend to have less high-quality teachers. Teachers have been unevenly distributed both within schools, such that students in lower academic tracks have had less well-qualified teachers (Kelly, 2004; Oakes, 1990), and across schools, such that qualifications of teachers tend to be lower in disadvantaged, low-income, and high-minority schools (Clotfelter, Ladd, Vigdor, & Wheeler, 2007; Hanushek, Rivkin & Kain, 2004). This inequitable distribution is troubling, especially since teachers' contribution to student achievement is thought to be especially strong for low-achieving students. Not surprisingly, these inequities in students' educational opportunities have been linked to disparities in educational outcomes. The achievement gap between more and less advantaged students can be attributed in part to the inequitable distribution of qualified teachers across schools (Clotfelter, Ladd & Vigdor, 2010).

Numerous educational policy efforts, including the highly qualified teacher provisions under the No Child Left Behind Act (NCLB), have sought to improve access to qualified teachers as a mechanism to enhance student achievement and reduce the achievement gap. Policies that attempt to increase student achievement by increasing students' access to teachers with specific credentials implicitly assume that such teachers are more capable of improving student achievement than their less-well-qualified counterparts. However, the efficacy of such policies has been called into question in light of research indicating weak or nonexistent links between teacher credentials and effectiveness.

While the measurable characteristics of teachers are in general weakly related to educational outcomes, research suggests that the strength of the relationship between teacher qualifications and student achievement may vary as a function of the grade and subject taught. For example, while elementary school teachers tend to be generalists, high school teachers often teach one or two subjects. Thus, subject-matter knowledge may be a more salient qualification for high school teachers than for elementary school teachers. Among high school mathematics teachers, researchers have found evidence that indicators of subject-matter knowledge are associated with teacher effectiveness (Goldhaber & Brewer, 1997; 2000).

The purpose of the current study is to explore high school mathematics students' access to teachers with qualifications associated with student achievement. I focus on teacher qualifications instead of effectiveness for three reasons: 1) data on teacher effectiveness are not available in national dataset; 2) as a practical matter, many school districts do not have information on teacher effectiveness either; thus, findings on teacher qualifications might more directly inform policies and decisions; and 3) teacher effectiveness could be influenced by school working conditions or context (Baker et al., 2010)—that is, the relationship between working conditions and teacher effectiveness may be endogenous, such that extremely poor working conditions make a teacher less effective or vice versa.

I examine high school mathematics students because the relationship between teacher qualifications and student achievement tends to be strongest in secondary mathematics (Rice, 2003; Wayne & Youngs, 2003). While this focus limits generalizability of the findings, student access to high school mathematics teachers with specific qualifications is likely to be related to student access to *effective* high school mathematics teachers. Consequently, the findings may

have stronger implications for student achievement and for achievement gaps between more and less advantaged students than do studies that explore teacher distribution more generally.

Drawing from a nationally representative sample of students enrolled in ninth grade mathematics during the 2009-2010 school year, I investigated ninth grade mathematics students' access to teachers with qualifications that have been linked to greater student achievement. Extending on prior work regarding the sorting of students to teachers, I explored sorting of students to teachers within schools as well as between schools. I used data from school year 2009-2010 to address whether students have inequitable access to teachers possessing qualifications that are associated with student achievement. Furthermore, I drew on previous research to explore the factors related to within- and between-school sorting in an effort to inform policies and practices at the federal, state, and local level intended to address inequities in access to human capital resources.

### **Review of the Literature**

The sections that follow present the findings organized by topic. I start by examining the work on the relationship between teacher qualifications and student performance on standardized assessments—I focus on research concerning teachers of mathematics as well as research on factors related to the distribution of teachers. I identify those qualifications that previous research indicates are related to student achievement and derive the outcome for my analyses based on these qualifications. Next, I review the literature on within-school sorting of students to teachers, and follow with reviews of literature on between school sorting along the dimensions of school context and working conditions.

Many researchers have explored how teacher retention is related to school context and working conditions, but less work has focused on the relationship between working conditions and student access to quality teachers. Since working conditions that are related to teacher retention may indirectly influence students' access to quality teachers, I include these studies in the review of the literature. School contextual factors and working conditions that are related to teacher retention are used in the current study as independent variables theorized to be related to students' access to quality teachers.

*Teacher Qualifications and Student Achievement.* Current education policies tend to focus on a subset of teacher characteristics that, while measurable, are not consistently related to teachers' impact on student achievement gains. For example, to be considered a "highly qualified" teacher under NCLB, teachers must have obtained at least a bachelor's degree, earned state certification in the grade and subject taught, and demonstrated subject matter knowledge. These criteria are intended to ensure a minimum competency level in order to protect students from incompetent teachers. In the following paragraphs I describe the research relating certification and subject matter knowledge to one specific indicator of teachers' competency—impact on student achievement gains.

Regarding certification, Aaronson, Barrow and Sander (2007) examined data on over 84,000 students attending public high schools in Chicago over a three-year period and found that certification status accounted for very little of the variance in teacher quality (as measured by value-added scores). In contrast, some evidence supports the notion that certification provides a "floor" of teacher quality and that teachers lacking certification are less effective. Goldhaber and Brewer (2000) used data from the National Educational Longitudinal Study (NELS) of 1988 to examine relationships between certification status and student achievement in twelfth grade.

Teachers with any type of certification to teach mathematics (emergency, alternative, or standard certification) outperformed teachers with no certification or teacher who were certified in a subject other than mathematics. Using administrative data on four cohorts of tenth graders in North Carolina, Clotfelter, Ladd, and Vigdor (2010) found that being certified in mathematics increases the average achievement of a teacher's students in a mathematics course by about 0.11 standard deviations.

Several studies reveal that indicators of high school mathematics teachers' content knowledge are related to student achievement gains. Using data from the Longitudinal Study of American Youth, Monk and King (1994) demonstrated that each additional course a teacher has taken in mathematics improves student mathematics achievement by about three quarters of one percent of a standard deviation. Both Rowan, Chiang, and Miller (1997) and Goldhaber and Brewer (1997, 2000) examined the NELS:88 data (a nationally representative sample). Rowan et al. found that having an undergraduate major in mathematics or a graduate degree in mathematics was a positive predictor of tenth-grade student achievement. Goldhaber and Brewer showed that after controlling for other characteristics, having a master's degree in mathematics is associated with student achievement gains in mathematics in both tenth grade (Goldhaber & Brewer, 1997) and in twelfth grade (Goldhaber & Brewer, 2000). Summaries of the literature on teacher characteristics and student achievement by Wayne and Youngs (2003) and Rice (2003) suggest that high school students learn more mathematics when their mathematics teachers have additional subject-specific degrees or coursework in mathematics and students learn more when their teachers have standard mathematics certification. However, in a more recent study using administrative data from Florida, Harris and Sass (2011) found no evidence that the quantity of mathematics coursework is associated with greater contribution to

student achievement. The inconsistency in findings may indicate that content knowledge is not a universally important trait for high school mathematics teachers—the relative importance of content knowledge may depend on the level or specific subject of the course taught, for example—or it may be that the quantity of mathematics coursework is not an especially strong proxy for content knowledge.

Studies that seek to isolate the impact of experience on the effectiveness of high school mathematics teachers yields mixed results. Using a North Carolina statewide administrative dataset with four cohorts of tenth graders (1999 through 2002), Clotfelter, Ladd and Vigdor (2010) demonstrated that experienced teachers outperform novice teachers. The authors concluded that teachers with some experience are more effective than novice teachers, but, beyond the first five years, additional experience adds little to teachers' effectiveness. Also using data on public schools in North Carolina, for school years 2005-2006 through 2009-2010, Henry, Fortner, and Bastian (2012) found that novice teachers of three different mathematics courses experience gains of 0.06 to 0.09 standard deviation units between their first and second year of teaching. Based on a statewide administrative dataset from Florida, Harris and Sass (2011) found that more experienced teachers appear more effective in teaching elementary and middle school mathematics; however, they did not find similar results for high school mathematics—in fact, they found that more experienced high school teachers are generally less productive than when they were novices.

*Inequities in the Distribution of Teachers: Within-School Sorting.* The manner in which teachers and students are sorted within schools may exacerbate inequality in access to educational resources, and specifically, the resource of human capital. For example, drawing on

data from the 1985-1986 National Survey of Science and Mathematics Education, Oakes (1990) found that teachers of low-track classes in junior and senior high schools were considerably less well-qualified than were teachers of other classes. Drawing on data from the nationally representative 1990-1991 Schools and Staffing Survey (SASS), Kelly (2004) found evidence that more experienced teachers are more likely to teach higher level courses at the high school level. Examining statewide data on public school teachers in Florida during the period 1997–2003 and the 1999–2000 SASS data and its Teacher Follow-up Survey (TFS) data set, Feng (2010) found that on average, Florida teachers with fewer than two years of experience had a larger proportion of low-performing students, students with disciplinary problems, minorities, low-income students, students in special education, and limited English proficient students. Using Miami-Dade County data spanning 2003-2004 through 2008-2009 school years, Kalogrides, Loeb, and Béteille (2011) demonstrated that, compared to more experienced colleagues in the same school and grade, less experienced teachers were assigned students with lower average prior achievement, more prior behavioral problems, and lower prior attendance rates.

The literature suggests that this sorting occurs in part because many teachers prefer higher-level classes. Raudenbush, Rowan, and Cheong (1992) showed that within a teacher's daily schedule, the difference between an academic and non-academic course lead to a 0.93 standard deviation increase in teacher satisfaction. As teachers gain experience and seniority, their desire for more satisfying class assignments may result in the patterns observed by Feng (2010) and Kalogrides, Loeb, and Béteille (2011). Kelly (2004) argued that this within-school sorting of teachers contributes to “the magnification of inequalities in opportunity to learn produced by tracking” (p. 55).

*Between-School Sorting: School Context.* Several researchers have found evidence of patterns in the between-school distribution of teachers, and have documented the disparities in teacher qualifications between schools based on the demographics of students served. In this section, I describe the research on teacher sorting along the dimension of school context, defined by Raudenbush and Willms (1995) as “school-level factors that are exogenous to practices of the school’s administrators and teachers” (p. 310), such as the socioeconomic and racial composition of the student body.

Student demographics have consistently been linked to teacher characteristics in studies showing that schools with greater proportions of low-income and minority students tend to have less well-qualified teachers than schools serving more advantaged student populations. For example, Hanushek, Rivkin, and Kain (2004) analyzed data on more than 300,000 Texas teachers during 1993-1996 and found that school characteristics played a large role in influencing teacher movements across schools and teacher exits from the system. Schools serving low-achieving students (as measured by district test scores) and larger proportions of minority students had greater difficulty retaining teachers than high-achieving, low-minority schools. The authors contend such distribution patterns reflect teacher preferences for higher-achieving students and non-minority students, though they acknowledge that student characteristics may be proxies for other factors that shape teachers’ preferences.

Using data from North Carolina public school students in fifth grade during 2000-2001, Clotfelter, Ladd, and Vigdor (2006) found evidence of between-school sorting such that teachers with better qualifications (more experience, degrees from more highly ranked colleges, or higher licensure test scores) typically work in schools serving higher proportions of advantaged students

(e.g. whiter, wealthier, with more highly educated parents and higher prior test scores).

Clotfelter, Ladd, Vigdor, and Wheeler (2007) noted similar patterns when comparing high and low poverty schools between 1995 through 2004; furthermore, they found that the differences between the percentages of inexperienced teachers in high and low poverty schools have increased over the ten-year period, to the disadvantage of students in high poverty schools.

Guarino, Brown, and Wyse (2011) explored data on all teachers in North Carolina from 1995 to 2006 and found that school demographic characteristics play a dominant role in intra-system sorting. Specifically, they found that wealthier and majority white schools attract a disproportionate share of first-year teachers with desirable characteristics such as degrees from highly competitive universities and high Praxis scores. In addition, teachers in “at-risk” schools (schools with both majority non-white and a high fraction of students in poverty) were more than two percent more likely to leave their school for another school in the district every year of their career, which amounts to a 40 percent increase in the probability of making this transition. Schools whose performance earned a classification as “low growth” under the state accountability policy struggle to retain teachers with desirable observable characteristics. Specifically, teachers with high Praxis scores, National Board certification, or a degree from a highly competitive undergraduate institution all show slightly higher probabilities of leaving the school system if they are in low-growth schools.

Using both statewide administrative data from Florida and the 1999-2000 SASS data, Feng (2010) found that compared to teacher with five or fewer years of experience, teachers with more than five but less than 30 years of experience were more likely to teach in schools with a smaller proportion of students with limited English proficiency, fewer poor students, and a

smaller proportion of minority students. Furthermore, in Florida, teachers with less than two years of experience taught in schools with lower average student achievement and more disciplinary incidents per student compared with teachers with more than six years of experience.

Using data on teachers working in the New York State system during the 1999-2000 school year, Lankford, Loeb, and Wyckoff (2002) found similar results. They examined teachers' experience, highest degree, certification, whether they passed the teacher exam on their first attempt, and college selectivity. Higher proportions of low-income, low-achieving, and non-white students have teachers with no teaching experience, teachers who are not certified, failed the teacher exam on the first attempt, or have a B.A. from a non-selective college, relative to non-poor, higher-achieving, and white students. Using administrative data from Georgia in school years 1994–1995 through 2000–2001, Scafidi, Sjoquist, and Stinebrickner (2007) found support for the notion that teachers are much more likely to leave high poverty schools, but also present evidence that teachers are more likely to leave a particular type of poor school: schools with a large proportion of minority students. Specifically, they find that in schools with one standard deviation higher than average percent Black students, teachers' average exit rate was 35 percent, compared to an exit rate of 29 percent on average across all schools.

Turning to mathematics teachers more specifically, and using nationally representative data from the SASS and TFS (focusing on 1999-2000 data), Ingersoll and Perda (2010) found that “high-poverty, high-minority, urban and rural public schools have among the highest rates of both attrition and migration of mathematics and science teachers. Moreover, in the case of those moving between schools, a large annual asymmetric reshuffling of a significant portion of the

math science teaching force creates a net loss on the part of poor, minority rural and urban schools and a net gain to nonpoor, nonminority suburban schools” (p. 588).

*Between-School Sorting: The Role of Working Conditions.* Though the research on school context suggests teachers prefer working with higher-income and white students, Hanushek, Rivkin and Kain (2004) acknowledged that student characteristics may be proxies for other factors that shape teachers’ preferences. That is, if lower income and minority students attend schools with less attractive working conditions, the patterns of teacher behavior that suggest a preference for wealthier and whiter students might be at least partially explained by preferences for better school working conditions. Such working conditions include administrative policies and the attitudes, values and expectations of students, teachers, and administrators (Ma, Ma & Bradley, 2008). Ingersoll’s (2001) work suggests that large numbers of qualified teachers depart their jobs out of dissatisfaction with aspects of the school climate, creating school staffing problems. Since student access to quality teachers may depend on whether their school is an attractive place to teach, in this section I describe the research on the relationship between teacher career decisions and various school working conditions, including the quality of leadership, colleagues, facilities and resources, degree of autonomy, adequacy of instructional and non-instructional time, and student behavior.

A number of studies have documented the importance of teachers’ perceptions of school leadership for teacher career decisions. Horng (2009) used a survey of 531 teachers in a California elementary school district to disentangle student characteristics and working conditions to determine if the characteristics of students themselves directly affected teachers’ decisions to migrate or served as proxies for working conditions in the schools. She found that

teachers identified school leadership as significantly more important than student characteristics when they were selecting a school in which to work. Using administrative data from North Carolina combined with a 2006 statewide survey administered to all teachers in the state, Ladd (2011) explored the relationship between teachers' working conditions and teachers' intended movement away from their schools. Independent of other school characteristics such as the racial mix of students, teachers' working conditions, especially school leadership, were highly predictive of teachers' intended movement away from their schools. Boyd et al. (2011) explored the relationship between school factors and teacher retention decisions in New York City; the authors modeled the relationship between the assessments of school working conditions by one set of teachers and the turnover decisions of other teachers in the same school. Similar to Ladd (2011), they found that teachers' perceptions of the school administration had the greatest influence on teacher retention decisions. Boyd et al. (2011) showed that teachers' perceptions of the school administration had much greater influence on teacher retention decisions than other factors examined, which included staff relations, student behavior, facilities, and safety.

Two studies based on the nationally representative SASS data and the TFS data confirm the findings from these local studies. Using 1990-1991 SASS data and 1991-1992 TFS data, Ingersoll (2001) found lower turnover rates in schools that provide more administrative support to teachers. In an exploration of the 2003-2004 SASS data and 2004-2005 TFS data, Grissom (2011) found that principal effectiveness is associated with greater teacher satisfaction and a lower probability that the teacher leaves the school within a year; furthermore, this positive impact of principal effectiveness on teacher retention is even greater in disadvantaged schools.

Both quantitative and qualitative studies find that teachers view relationships with and perceptions of their colleagues as a factor in teacher retention. Based on a survey of a stratified random sample of 400 teachers in Washington State, Elfers, Plecki, and Knapp (2006) reported that 90 percent of teachers consider the presence of staff with whom they feel comfortable working, collegial community with other teachers, and presence of staff who share their values about teaching and schooling to be moderate or strong reasons to stay in their school. Johnson, Kraft, and Papay (2012) found similar results based on a 2008 survey of teachers and their working conditions in Massachusetts; the extent to which teachers have productive working relationships with their colleagues was a statistically significant predictor of both teacher satisfaction and stated intention to remain in the school.

School facilities and resources may also play a role in attracting teachers, though evidence regarding the relationship between facilities and teacher retention is mixed. Teachers in an elementary school district in California identified school facilities as being significantly more important than student characteristics when teachers were selecting a school in which to work (Horng, 2009). Johnson, Kraft, and Papay (2012) found that facilities and resources were especially relevant factors regarding whether teachers planned to transfer schools. In contrast, Ladd (2011) found teachers' perceptions of facilities to be a significant predictor of teachers' departures among elementary school teachers, such that teacher departures were actually higher in schools in which teachers had positive perceptions of the facilities; however, perceptions of facilities were not a significant predictor of departure among middle and high school teachers.

Teachers' autonomy and roles in school governance have also been linked to teacher retention. Analyses of multiple waves of the SASS data and TFS data indicate that schools with

higher levels of faculty decision-making influence and autonomy have lower levels of turnover (Ingersoll, 2001; Ingersoll & May, 2012). In Johnson, Kraft, and Papay's (2012) study of teachers in Massachusetts, teachers in schools where school average perceptions of teacher involvement in decision-making were higher were less likely to plan to transfer or leave the profession. Teacher autonomy may be especially important in terms of mathematics teachers' career decisions. Ingersoll and May (2012) found that a one-unit increase in average teacher autonomy between schools was associated with a 70 percent decrease in the odds of a mathematics teacher departing and was by far the single largest relationship between working conditions and turnover that they found (p. 453).

In Johnson, Kraft, and Papay's (2012) analysis of survey data from Massachusetts teachers, the authors found that teachers' perceptions of whether teachers have sufficient instructional and non-instructional time were significantly related to teachers' intentions to remain in their schools. Similarly, Ladd (2011) found that middle schools teachers' perceptions of having sufficient time for planning and collaboration were associated with lower likelihood of moving or leaving the profession. Among elementary school teachers, those who reported spending more time on school-related activities outside the regular school work day were more likely to plan to move to another school or district. However, teachers' perceptions of the adequacy of time for planning and collaboration were not a significant predictor of teachers' actual departures (Ladd, 2011). Thus, while teachers expressed a preference for settings that provide time for preparation and planning, it is not clear whether this factor has a strong bearing on teacher career decisions.

Schoolwide disciplinary climate also influences teachers' decisions about where to work. Consistent with Ingersoll's (2001) earlier findings based on analysis of the 1990-1991 SASS data, Ingersoll and May's (2012) analysis of the 2003-04 SASS data indicates that turnover is lower in schools where teachers perceive fewer discipline problems. Similarly, Boyd et al. (2011) find that retention of teachers in New York City is higher in schools with more positive ratings of student behavior. All three studies control for school context variables such as the proportion of students receiving subsidized meals.

### **Current Study**

The existing literature has explored teacher satisfaction, retention, and turnover as outcomes related to working conditions. Although the considerable amount of turnover in the teaching profession is costly and time-consuming, and the body of work reviewed here suggests that the costs of teacher turnover are borne disproportionately by disadvantaged students, as Ingersoll and May (2012) note, some turnover is "normal, inevitable, and can be efficacious" (p. 436) for individuals and organizations. Most of these studies do not directly address whether teacher turnover (or retention or satisfaction) creates inequities in education opportunities by leaving disadvantaged students with teachers of lower quality.

In this study, I explore the extent to which working conditions are related to ninth grade mathematics students' access to quality teachers. Since teachers are among the most critical schooling resources, student access to quality teachers is a key component of their educational opportunities. Working conditions that influence teacher satisfaction and turnover might be viewed as factors that can predict students' access to quality teachers. In this study, I build on

prior research to investigate whether factors that influence teacher satisfaction and turnover are also related to student access to quality teachers.

I updated past work using 2009 data to explore variation in ninth grade mathematics students' access to quality teachers. My definition of a "quality" teacher is based on previous research on the qualifications that are related to high school mathematics teachers' productivity, as measured by student achievement (Goldhaber & Brewer, 2000; Wayne & Youngs, 2003). High school students' access to quality mathematics teachers should be of direct interest to policy makers, since the relationship between teacher qualifications and student achievement appears to be strongest in high school mathematics (Rice, 2003).

While some prior studies have used multilevel approaches to account for teachers being nested within schools (e.g. Ingersoll & May, 2012), fewer studies have used multilevel modeling to take into account the sorting of students to teachers within schools as well as across schools. The current study is unique in that it extends on prior work by using nationally representative data to explore factors related to students' access to quality teachers both within and between schools.

While it is possible that school context moderates the relationship between working conditions and students' access to quality teachers, few researchers have explored whether the relationships between working conditions and their outcomes are contingent upon contextual factors. Those that do so have found significant interactions. For example, Grissom (2011) found that the positive impact of principal effectiveness on teacher retention is even greater in disadvantaged schools. His finding suggests the importance of considering contingent relations in studies that investigate the impact of school working conditions. Similarly, Ladd (2011) finds

that teachers' intended departures are more responsive to the quality of school leadership in schools with higher proportions of Black students compared to schools with lower proportions of Black students. By including measures of both school context and working conditions, the conceptual framework of the current study extends on previous studies and offers insight as to the extent to which school context moderates the relationship between working conditions and students' access to quality teachers.

The specific research questions are below:

1. Within schools, do the odds of having a “quality”<sup>2</sup> mathematics teacher differ depending on students' academic and demographic characteristics?
2. Between schools, are students in schools with less favorable contexts (e.g. schools serving predominantly lower-achieving students of lower socioeconomic status) less likely to have quality teachers relative to students in schools serving more advantaged populations?
3. Do school working conditions influence students' access to quality teachers across schools? Does school context explain variation across schools in the relationship between student background and the odds of having a quality teacher?

In sum, this study contributes to the literature base by: 1) using a nationally representative dataset compiled since the passage of the No Child Left Behind Act, whereas prior studies have focused on specific states and/or districts or data from the 1990s; 2) investigating within-school sorting as well as between-school sorting of teachers; and 3) building on prior studies of teacher preferences to examine whether demographics of the school population and teachers' working

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<sup>2</sup> For the purpose of this study, I define a “qualified” teacher based on prior research regarding the teacher characteristics that have been associated with greater student achievement gains in high school mathematics. These characteristics include: certified to teach mathematics in grades nine through twelve, five or more years of experience teaching high school mathematics, and at least one of the following: a BA in mathematics/statistics, a highest degree in mathematics/statistics, or seven or more courses in mathematics/statistics.

conditions are related to sorting of high school mathematics teachers to students, and whether teachers' working conditions moderate sorting based on student demographics.

As opposed to previous work, which focuses on teacher satisfaction and/or turnover as an outcome, this study investigates students' access to teacher with qualifications known to be related to student achievement. As noted in the literature review, though teacher qualifications are generally weakly related to achievement, subject-specific training and credentials do appear to matter in the context of high school mathematics (Rice, 2003). Since the analytic sample consists of students enrolled in high school mathematics courses, these qualifications include certification in mathematics and degrees or significant coursework in mathematics. Of particular interest is whether positive working conditions might mitigate the expected positive matching of teachers to students—in other words, whether positive working conditions can increase the likelihood that less advantaged students are exposed to quality teachers.

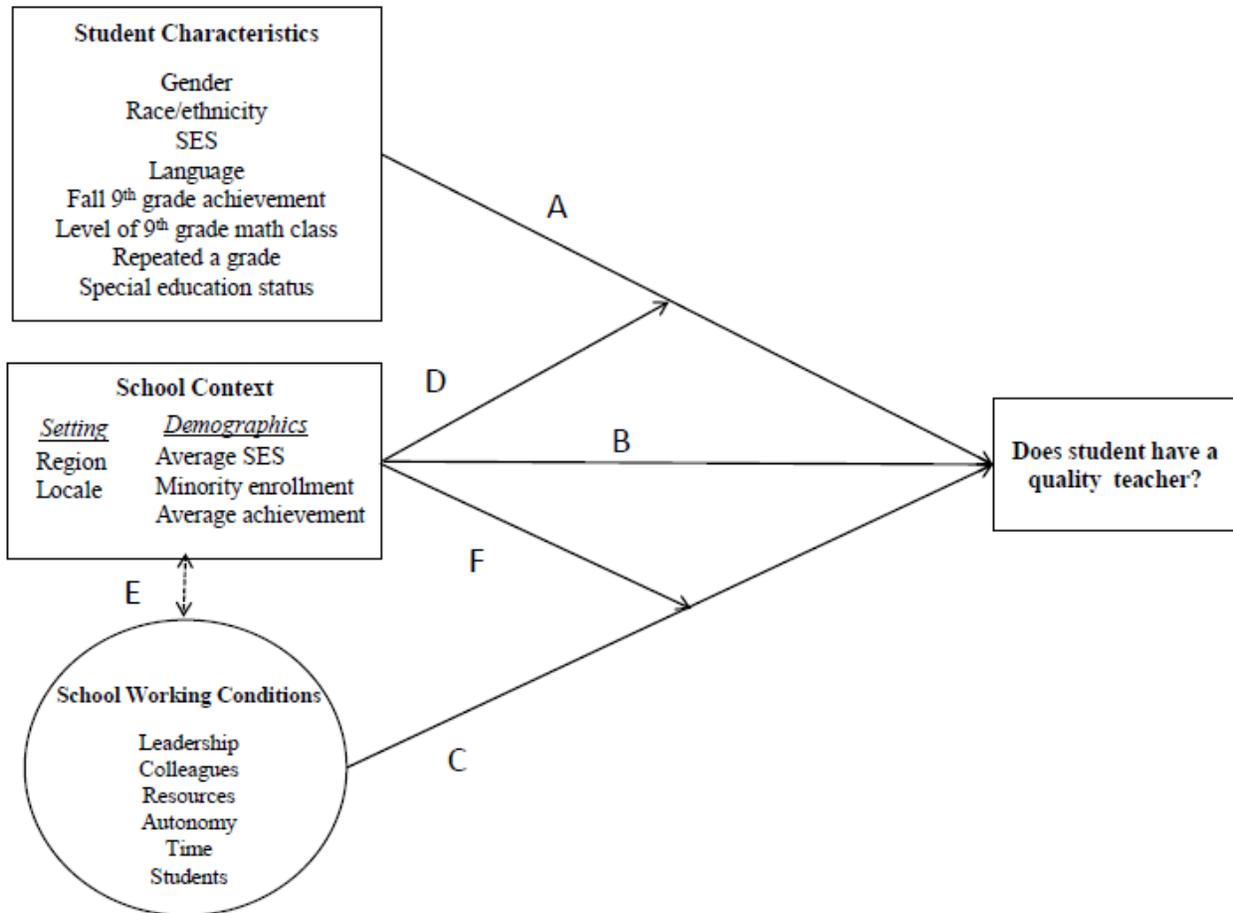


Figure 2.1. Multilevel heuristic model relating students’ academic background and teachers’ working conditions to the probability of a student having a quality teacher.

The conceptual model in Figure 2.1 delineates hypothesized relationships between variables. Within schools, I expect higher-achieving students and those in higher level mathematics classes to have a higher probability of having a quality teacher; conversely, I expect students in lower level mathematics classes to have a lower probability of having a quality teacher. The main effect of students’ academic background on the likelihood of having a quality teacher is depicted by arrow A in Figure 1. The analytic results captured by arrow A address research question 1. I hypothesize that students in schools with more favorable contexts—e.g. schools serving wealthier students with higher average levels of achievement—have greater

access to quality teachers.<sup>3</sup> The relationship between school context and student access to a quality teacher is indicated by arrow B. The analytic results that are captured by arrow B address research question 2.

Between schools, I include arrow C to indicate the direct effect of working conditions on the likelihood of having a quality teacher. Since the literature suggests teachers stay longer in schools with positive work environments (Johnson, Kraft & Papay, 2011) and more effective principals (Grissom, 2011), I expect students to have greater access to quality teachers in schools with more favorable working conditions. The analytic results captured by arrow C address research question 3.

I hypothesized that the relationship between student background and access to a quality teacher might vary across schools. I explore whether aspects of school context moderate the within-school relationship between students' academic background and access to quality teachers. School context may strengthen or attenuate the relationship between students' background and their access to quality teachers. Arrow D indicates this hypothesized cross-level interaction. Based on prior research, I expect working conditions to be correlated with school context, represented by the double-headed dashed arrow E. Finally, prior work suggests that certain working conditions have a more positive effect in challenging environments than they do in the average school (Grissom, 2011). Therefore, I allow for the possibility that school-level factors might interact, such that working conditions have a stronger influence on some schools than others. These potential interactions are denoted by arrow F.

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<sup>3</sup> I expect qualified teachers to be attracted to schools with favorable context, including higher achievement, based on prior research. One might speculate that the teacher's qualifications are causally related to student achievement. However, the achievement measure is taken from the fall of ninth grade, before teachers have an opportunity to influence achievement.

### Data Source

I use data from the High School Longitudinal Study of 2009 (HSL:09) for this study. Sponsored by the U.S. Department of Education's National Center for Education Statistics (NCES), the HSL:09 base year data include a randomly selected sample of over 21,000 ninth grade students in more than 900 public and private high schools. Students took assessments and a survey online; students' parents, principals, and mathematics and science teachers completed surveys on the phone or on the Web (Ingels et al., 2011).

Sample selection for the HSL:09 was based on two-stage process. First, stratified random sampling and school recruitment resulted in the identification of 1,889 eligible schools, of which 944 participated. In the second stage of sampling, students were randomly sampled from each the participating schools. The sampling process yielded 25,206 eligible students (about 27 students per school). The weighted student assessment completion rate in the based year was 83 percent and the weighted school administrator completion rate was about 95 percent. The weighted mathematics teacher response rate was about 72 percent (Ingels et al., 2011).

The HSL:09 dataset provides several types of sampling weights to account for the complex survey design and to produce estimates for the target population. The use of weights is required to produce estimates for the target population. In the descriptive analyses, the mathematics course enrollee weight (W1MATHTCH) is used to produce subpopulation estimates for ninth grade students enrolled in a mathematics course, and the school weight (W1SCHOOL) is used to produce population estimates for U.S. schools providing instruction to students in grades nine through eleven (Ingels et al., 2011). To account for complex sampling in a multilevel framework, I applied the base year math-course enrollee analytic weight (W1MATHTCH) to level-1 and the school weight (W1SCHOOL) to level-2.

Although the full HSLs:09 sample includes data for 26,305 ninth graders, I restricted the analytic sample used to public school students who could be linked to a mathematics teacher in the ninth grade. I limited the sample to public schools because private schools are not bound by as many regulations in hiring and retaining teachers, and working conditions in private schools are likely different from working conditions in public schools in ways that are difficult to measure. I limited the sample to students who could be linked to a mathematics teacher because the outcome required data on each student's mathematics teacher. I also restricted the analyses to students in schools in which at least two mathematics teachers responded to the survey because schools with only one mathematics teacher responding to the survey would not exhibit any within-school variation in access to quality teachers. Finally, I removed students whose teachers failed to provide information about their qualifications from the analytic sample. Based on these criteria, the analytic sample includes approximately 12,400 ninth grade students enrolled in approximately 710 schools (roughly 47 percent of the full sample). On average, schools in the sample have approximately 17 students each.

Students in the analytic sample have lower socioeconomic status (SES) compared to the excluded students; a lower percentage are White and higher percentages are Black or Hispanic. Students in the analytic sample have lower levels of achievement on the fall mathematics assessment than those excluded from the sample. Compared to the teachers of excluded students, the mathematics teachers of students in the analytic sample have less experience (12 years vs. approximately 15 years). Compared to those excluded from the analytic sample, students in the analytic sample are more likely to have a mathematics teacher that meets the definition of quality used in this study (36 percent compared to 26 percent). These differences are expected given that many of the excluded students attend private schools, and teachers in

private schools are exempt from many of the requirements around qualifications that public school teachers face.

I used multiple imputation to avoid additional loss of cases due to missing data. Multiple imputation has become a highly regarded method of handling missing data because it provides sound parameter estimates (McKnight, McKnight, Sidani, & Figueredo, 2007). Multiple data sets are generated with different estimates of the missing values, which are then used in analysis (Enders, 2010).

### **Measures**

The HSLS:09 provides a range of information about students, students' mathematics teachers, and students' schools. The measures used in the current study are described below.

**Quality teacher:** a dichotomous variable where 1 = quality and 0 = other teachers.<sup>4</sup> To be considered quality, a teacher must be 1) certified to teach high school mathematics, 2) in 5<sup>th</sup> or higher year of teaching high school mathematics, and 3) have either a BA or higher degree in mathematics or statistics, or have taken at least seven different courses in mathematics and/or statistics.

### **Student Characteristics**

- **Female:** dichotomous variable where 1 = female and 0 = male.

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<sup>4</sup> In the analytic sample which excludes private schools, 98.8 percent of students were taught by teachers certified to teach high school mathematics in grades nine through twelve. Variation in the outcome was mainly related to subject matter knowledge. Given the conflicting findings regarding the relationship between experience and teacher effectiveness among high school math teachers (Harris & Sass, 2011; Clotfelter, Ladd, & Vigdor, 2010; Henry, Fortner & Bastian, 2012), I constructed two outcome measures: the one described and another that does not incorporate experience at all. Results were substantively similar. Findings presented use the outcome described in main text.

- **Race/ethnicity:** a series of dichotomous indicators regarding whether the student is Black, Hispanic, Asian, or Other, where 1 = yes and 0 = no. The reference group is White.
- **SES:** the NCES-constructed continuous index score based on five components derived from the base year parent questionnaire: education of each parent or guardian; the occupational prestige score of each parent or guardian; and family income.
- **Language:** a dichotomous indicator of whether the student is classified as an English language learner (ELL), coded as 1 = ELL and 0 = not ELL.
- **Fall ninth grade achievement:** students' mathematics IRT score.
- **Level of ninth grade math class:** two dichotomous indicators of the level of mathematics class, categorized based on the mathematics achievement scores of individual taking the courses. High level class is coded as 1 = advanced mathematics, integrated math II, trigonometry algebra II and geometry; 0 = other courses. Low level class is coded as 1 = remedial mathematics, pre-algebra, "other" math and 0 = other courses.
- **Special education status:** dichotomous indicator where 1 = student in special education; 0 = student not in special education.
- **Whether repeated a grade:** dichotomous indicator where 1 = student repeated at least one grade and 0 = student never repeated a grade.

### School Characteristics

- **Region:** a series of dichotomous indicators of whether the school is in the West, Midwest, or Northeast, where 1 = yes and 0 = no. The reference group is South.

- **Locale:** a series of dichotomous indicators of whether the school is located in a town, rural area, or city, where 1 = yes and 0 = no. The reference group is suburb.
- **Average SES:** student socioeconomic status derived with locale, aggregated to the school level.
- **Minority enrollment:** a dichotomous variable where 1= proportion of non-White students exceeded 45 percent and 0 = proportion of non-White students less than 45 percent.<sup>5</sup>
- **Average achievement:** student scores on the mathematics assessment given in the fall of ninth grade, aggregated to the school level.

### Working Conditions

- **Leadership:** on a four-point continuum, the school mean of students' mathematics teachers' reports for five items regarding whether the principal: deals with outside pressures interfering with teaching, sets priorities and sees that they are carried out, communicates to staff the kind of school that is wanted, lets staff members know what is expected of them, is interested in innovation and new ideas, and consults staff before making decisions affecting them.  $\alpha=0.899$ .
- **Colleagues:** four continuous variables capturing facets of the school environment that are shaped by colleagues.
  - **Math teacher expectations:** on a four-point continuum, the school mean of students' mathematics teachers' reports for eight items regarding whether mathematics teachers in this school: set high standards for teaching, set high

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<sup>5</sup> The distribution of the proportion of non-minority students is noticeable non-normal: it is bimodal, with many schools have either no minorities in the sample or all minorities. I take an approach similar to that used by Lee and Burkam (2003), in which the proportion is dichotomized for the regression analysis.

standards for students' learning, believe all students can do well, make goals clear to students, have given up on some students, care only about smart students, expect very little from students, and work hard to make sure all students learn.  $\alpha=0.849$ .

- **Collective responsibility:** on a four-point continuum, the school mean of students' mathematics teachers' responses to seven items as to whether teachers at this school: help maintain discipline in the entire school, take responsibility for improving the school, set high standards for themselves, feel responsible for developing student self-control, feel responsible for helping each other do their best, feel responsible that all students learn, and feel responsible when students in this school fail.  $\alpha=0.876$ .
- **Collegial sharing:** on a four-point continuum, school mean of students' mathematics teachers' perceptions of six items regarding whether mathematics teachers in this department: share ideas on teaching, discuss what was learned at workshop/conference, share and discuss student work, discuss lessons that were not successful, discuss beliefs about teaching/learning, and share research on effective teaching methods.  $\alpha=0.894$ .
- **Collegial support:** on a four-point continuum, school mean of students' mathematics teachers' perceptions of five items regarding whether mathematics teachers in this department: share research on English Language Learner instructional practices, explore approaches for underperforming students, coordinate course content with other teachers, provide support to new

mathematics teachers, and are supported/encouraged by mathematics department's chair.  $\alpha=0.786$ .

- **Resources:** on a 4-point continuum, the school mean of students' mathematics teachers' reports for seven items. The first six items ask whether teaching is limited by shortage of: computer hardware/software, support for using computers, textbooks for student use, instructional equipment for students, equipment for demonstrations, or by inadequate physical facilities. The last item asks whether lack of teacher resources and materials is a problem at this school (four-point continuum from "not a problem" to "serious problem").  $\alpha=0.830$ .
- **Autonomy:** mathematics teachers' perceptions of whether teaching is limited by a lack of autonomy in instructional decision-making, reverse coded and dichotomized (0=teaching is limited by lack of autonomy; 1=teaching is not at all limited by lack of autonomy). I dichotomized autonomy after aggregating to the school level (1=more two-thirds of students' mathematics teachers report that teaching is not limited by lack of autonomy).
- **Time:** mathematics teachers' perceptions of whether teaching is limited by a lack of planning time, reverse coded and dichotomized (0=teaching is limited by lack of planning time; 1=teaching is not at all limited by lack of planning time). I dichotomized time after aggregating to the school level (1=more two-thirds of students' math teachers report that teaching is not limited by lack of planning time).
- **Students:** two continuous variables capturing facets of the school environment that are shaped by students.

- **Student problems:** four-point continuum, the school mean of students' mathematics teachers' responses to eight items regarding: student tardiness, absenteeism, class cutting, dropping out, apathy, lack of parental involvement, unprepared to learn, and poor health.  $\alpha=0.874$ .
- **School climate:** on a five-point continuum, principal ratings regarding the frequency of 14 types of events at this school: physical conflicts among students, robbery or theft, vandalism, student illegal drug use, student use of alcohol while at school, drug sales on way to/from school or on school grounds, student possession of weapons, physical abuse of teachers, student racial tensions, student bullying, student verbal abuse of teachers, in-class misbehavior, student acts of disrespect for teachers, and student gang activities.  $\alpha=0.837$ .

Higher values represent more positive assessments of working conditions, except in the case of student problems. Unless otherwise noted, teachers responded along a continuum of “strongly agree” to “strongly disagree”. I reverse-coded some questionnaire items to equate larger scale values with positive attributes. I used factor analysis to create measures of leadership, mathematics teacher expectations, collective responsibility, resources, and student problems; each set of items yielded a single factor score. I also conducted factor analysis of items related to professional learning community, which yielded two factor scores via varimax rotation of the components. I labeled these two factors collegial sharing and collegial support. All factor scores were created at the student level and aggregated to the school level.

### **Analytic Approach**

I calculated population estimates of the means of continuous variables and percentages for categorical variables in SPSS for each of the dependent and independent variables included in

the analyses. I used a factorial ANOVA to test for differences in student characteristics by whether the teacher meets the definition of quality used in this study. When conducting descriptive analyses of HSLs:09 student-level data, I weighted the data and used the complex samples module in SPSS to account for different rates of non-response and the complex sample design.

The research questions are situated in a multilevel framework, which recognizes the nested structure of students within schools (Raudenbush & Bryk, 2002). Single-unit approaches (i.e. using the school or student as the unit of analysis) require untenable assumptions. School-level analyses ignore variability in both the outcome and in independent variables across students within schools, while student-level analyses may result in underestimation of standard errors. In addition, the researcher must assume that the outcomes of all students in the school are identically influenced by the school-level independent variable (Lee, 2000). Multilevel models allow simultaneous modeling of relationships within and across multiple units of analysis, and allows for heterogeneity of regression slopes, such that the relationship between student characteristics and the outcome may vary across schools. Thus, to explore students' access to quality teachers, I used a multilevel logistic regression model to explore whether student characteristics (level-1) and school characteristics (level-2) explain variation in ninth grade mathematics students' access to quality teachers. I analyzed the multilevel regression models using HLM version 6.08 (Raudenbush, Bryk, Cheong, & Congdon, 2000).

The level-1 model is used to address research question 1 and determine whether student characteristics—socioeconomic status, gender, race, special education and English language learner status, whether the student repeated a grade, prior mathematics achievement, and the

mathematics course taken by the student (high level vs. low level)—are related to the odds of the student having a quality teacher. I modeled whether a student has a quality teacher  $i$  in school  $j$  as a function of these student characteristics ( $X_{qij}$ ).

$$\eta_{ij} = \beta_{0j} + \beta_{qj}X_{qij} \quad [2.1]$$

Where  $\eta_{ij}$  is a dummy variable indicating whether a student  $i$ 's teacher in school  $j$  meets the definition of quality used in this study;  $\beta_{0j}$  is the average proportion of students in school  $j$  whose teacher are considered quality teachers;  $X_{qij}$  is the vector of  $q = 1, \dots, q$  indicators associated with student and course characteristics; and  $\beta_{qj}$  are the level-1 coefficients indicating the direction and strength of association between student and course characteristics and whether the student had a quality teacher.

In order to determine whether student characteristics are related to the odds of the student having a quality teacher, I first entered each level-1 predictor to the model for  $\eta_{ij}$  group-mean centered and allowed to vary across schools to assess 1) whether each characteristic is significantly related to the odds of having a quality teacher, and 2) whether the relationship between the characteristics and the odds of having a quality teacher varied across schools. In cases where the relationship between the predictor and the odds of having a quality teacher did not vary across schools, I re-specified the model by centering the predictor on the grand mean. In the final level-1 model, all predictors are included regardless of statistical significance. All predictors except mathematics achievement are grand-mean centered.

To address research question two, regarding whether students' access to quality teachers is influenced by school context, I modeled  $\beta_{0j}$  (the schools' log-odds of students having a

quality teacher) as a function of a vector of aggregated characteristics of students in the school ( $Context_{sj}$ ) and random school error ( $u_{0j}$ ):

$$\beta_{0j} = \gamma_{00} + \gamma_{1s}(Context)_{sj} + u_{0j} \quad [2.2]$$

Where  $\beta_{0j}$  is the average log-odds of students having a quality teacher in school  $j$ ;  $\gamma_{00}$  is the average log-odds of students having a quality teacher across all schools;  $Context_{sj}$  is the vector of  $s = 1, \dots, s$  school contextual variables (i.e. average prior achievement, high minority, and SES);  $\gamma_{1s}$  are the level-2 coefficients indicating the direction and strength of association between the school context and average log-odds of having a quality teacher; and  $u_{ij}$  is the school-level random error or unique effect of school  $j$  (the deviation of the school's level-2 coefficient from its predicted log-odds).

My approach to building the model at level 2 was similar to the approach I used to build the model at level 1. In developing the model at level 2, I first entered each school contextual factor separately into the model. I entered the continuous variables (school average mathematics scores and SES) grand-centered and the dichotomous variable (high minority) uncentered. In the final school context model, I included each factor regardless of statistical significance.

To answer the first part of the third research question, I expanded on the model for  $\beta_{0j}$  (the school average log-odds of its students having a quality teacher) by adding a series of working conditions and assessing whether the coefficients on school context related to odds of having a quality teacher are decreased by any of these additions. I explored each of the working

conditions described in the measures section individually.<sup>6</sup> I entered dichotomous level-2 variables uncentered and continuous variables grand-centered. To investigate whether the effect of working conditions is different in different types of schools (i.e., a contingent relationship), I computed a series of product terms between the working conditions and school context measures, average socioeconomic status and average prior achievement (Context\*WC in equation 2.3 below). In the final models, I include only those working conditions that have either a statistically significant main effect on the outcome or that are part of a statistically significant interaction term.

$$\beta_{0j} = \gamma_{00} + \gamma_{1s}(\text{Context})_{sj} + \gamma_{2s}(\text{Working Condition})_{sj} + \gamma_{3s}(\text{Context} * \text{WC})_{sj} + u_{0j} \quad [2.3]$$

To address the second part of the third research question, I added level-2 predictors to the model for  $\beta_{1j}$  (the relationship between student achievement and log-odds of having a quality teacher). I explored school contextual factors and working conditions that might increase or decrease within-school sorting to assess whether the relationship between student achievement and odds of having a quality teacher is moderated by particular facets of the school environment.

$$\beta_{1j} = \gamma_{10} + \gamma_{1s}(\text{School Context})_{sj} + \gamma_{2s}(\text{Working Conditions})_{sj} + u_{1j} \quad [2.4]$$

Because it is difficult to interpret the coefficient in a logit regression, in the results section I present the odds ratios, calculated as  $\exp(\beta_j)$ , where  $\beta_j$  is the estimated coefficient. In general, an odds ratio greater than one suggests that a one-unit increase in the predictor is

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<sup>6</sup> Because each of these constructs is aggregated from the student to the school level, I explored whether the standard deviation (as a proxy for consistency of teacher perceptions) contributes to the model, but this analysis did not reveal substantive findings. Following Ingersoll and May (2012), I also portioned the variation of each measure of working conditions within-school and between-school components. The intraclass correlation, or proportion of variance between schools, ranged from 0.56 for collegial sharing to 0.69 for student problems, indicating that part of each measure is unique to students' teachers and part is common to all teachers within a school.

associated with an increased probability of having a quality teacher compared with the default of not having a quality teacher. An odds ratio of less than one implies that a one-unit increase in the predictor is associated with a decreased probability of having a quality teacher.

Using SPSS, I created 10 multiple imputation datasets in order to retain all cases in the analytic sample. For most school variables, less than ten percent were missing data (exceptions were the school-level NCES scales of administrator and counselor perceptions, with about 20 percent and 15 percent missing, respectively). I used these datasets to create ten Multivariate Data Matrix files for HLM to conduct the multilevel analyses.

To provide the most accurate standard errors for school level coefficients, I included the stratification variables, region and locale, in the between-schools model as suggested by L. Stapleton (personal communication, December 19, 2012). I report the population average results, which are robust to erroneous assumptions about the random effects in the model (Heagarty & Zeger, 2000), and are more useful than the unit-specific results when desired inferences focus on group-level variables (O’Connell, Goldstein, Rogers & Peng, 2008). The term “likelihood” is used in a nontechnical sense; a greater likelihood of having a quality teacher could refer to a greater probability, greater odds, or greater log odds (Lee & Burkam, 2003).

## **Results**

While the vast majority of public school students have teachers who are certified to teach high school mathematics, only about 54 percent of students have mathematics teachers with a degree or significant coursework in mathematics. Overall, about 39 percent of public school ninth grade mathematics students have a mathematics teacher meeting the construction of “quality” used in this study. As seen in Table 2.1, relative to students with teachers who do not

meet this definition of quality, a greater proportion of students whose teachers meet this definition of quality are White, and a lower proportion have repeated a grade or are in a low mathematics course or special education. In addition, the students of quality teachers have higher average SES and mathematics achievement compared to the students of teachers that do not meet this definition of quality.

Table 2.1 Student Characteristics by Teachers' Qualification Status

	All	Quality	Not Quality	
<i>Variables:</i>				
% Female	49.81	50.35	49.51	***
% White	51.48	56.16	48.84	***
% Asian	3.54	3.68	3.46	***
% Black	13.09	11.78	13.83	***
% Hispanic	22.71	19.70	24.40	***
% Other	9.81	8.67	9.47	
Mean SES	-0.11	-0.02	-0.16	***
(SE)	(0.02)	(0.02)	(0.02)	
Mean math achievement	38.94	40.31	38.16	***
(SE)	(0.29)	(0.39)	(0.37)	
% High math	29.72	32.02	28.42	***
% Low math	9.91	9.08	10.37	***
% ELL	1.93	1.65	2.09	***
% special education	6.71	5.25	7.53	***
% repeated a grade	8.95	6.76	10.19	***

Note. Based on an analytic sample of approximately 12,400 students linked to mathematics teachers in public schools.

~ p < 0.10 \* p < 0.05 \*\* p < 0.01 \*\*\* p < 0.001

In the remainder of the results section, I present the results of the multilevel analyses in the order of the research questions.

#### Student background characteristics and students' access to quality teachers

I present the results of the analyses investigating the relationship between students' demographic background and the likelihood of having a quality mathematics teacher in 2.2. I estimated each of the independent variables shown in Table 2.2 as fixed effects, centered around

the mean for the entire sample.<sup>7</sup> I standardized socioeconomic status ( $M = 0$ ,  $SD = 1$ ), the only continuous variable in these models. All other variables are dichotomous.

Equitable access to quality teachers would be indicated by a lack of relationship between student characteristics and odds of having a quality teacher. Although the descriptive results in Table 2 indicated students with quality teachers differed from students with teachers who did not meet this definition of quality along nearly every dimension, the multivariate results indicate that within schools, the odds of having a quality mathematics teacher are unrelated to students' gender, socioeconomic status, and English language learner status. Although Black and Asian students are no more or less likely to have quality teachers compared to non-minorities, Hispanic students and those classified as other race are less likely than White students to have a quality teacher.

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<sup>7</sup> Given the within-school sample sizes, only a small subset of student-level predictors may be modeled as having random effects. Preliminary analyses showed that the effects of student demographic predictors showed little evidence of having random effects; thus, I constrained these predictors to be fixed for the purpose of this investigation.

Table 2.2 Odds Ratios from Within-School Models: Student Demographic Characteristics and the Likelihood of Having a Qualified Teacher

	Model 1 Female		Model 2 Race		Model 3 SES		Model 4 ELL	
Intercept	0.345	(0.195)	0.352	(0.196)	0.348	(0.194)	0.345	(0.195)
Female	1.017	(0.054)						
Black			0.844	(0.107)				
Hispanic			0.844	(0.086) *				
Asian			1.003	(0.169)				
Other			0.815	(0.097) *				
SES					1.054	(0.040)		
ELL							1.017	(0.172)
<i>Variance Components Table</i>								
Intercept	4.068	***	4.034	***	4.030	***	4.068	***
<i>Reliability</i>								
Intercept	0.849		0.848		0.848		0.849	

Note. Analyses weighted by W1MATHTCH at level 1, and by W1SCHOOL at level 2. Models control for locale and region at level 2.

\* p < 0.05 \*\* p < 0.01 \*\*\* p < 0.001

In Table 2.3, I present the results of the analyses investigating the relationship between students' academic background and the likelihood of having a quality mathematics teacher. Based on preliminary analyses, I estimated all independent variables shown in Table 2.3 as fixed effects, centered on the mean for the entire sample, with one exception. The relationship between students' prior mathematics achievement and the outcome varies significantly across schools; therefore, I entered mathematics achievement group-mean centered with a random effect.<sup>8</sup> Mathematics score, the only continuous variable in these models, was standardized ( $M = 0$ ,  $SD = 1$ ); all other variables are dichotomous.

<sup>8</sup> While preliminary analyses suggested that high and low level mathematics classes had random effects, inclusion of random effects lead to the loss of schools that did not have both types of classes. Hence, with the exception of prior mathematics achievement, effects of student-level predictors were constrained to be fixed for the purpose of this investigation.

While most student demographic characteristics are unrelated to odds of having a quality teacher, certain academic background variables significantly predicted students' odds of having a quality teacher, as seen in models 1 through 4 in Table 2.3. Special education students are less likely to have quality teachers (a 23 percent decrease in the odds of having a quality teacher), as were students enrolled in low-level mathematics courses. Being in a low level mathematics course is associated with a 22 percent decrease in the odds of having a quality teacher. In contrast, students enrolled in high-level mathematics courses and students who had repeated a grade are no more or less likely to have quality teachers relative to their peers.

In model 4, I find that mathematics achievement had a significant main effect on odds of having a quality teacher. Compared to students with average mathematics achievement, odds of having a quality teacher are 1.11 times greater for students whose mathematics achievement is one standard deviation higher than average. I also found that the relationship between mathematics achievement and odds of having a quality teacher varied significantly across schools. That is, in some schools students' mathematics achievement is more strongly related to their odds of having a quality teacher than in other schools. Schools in which the relationship was weaker provided more equitable access to quality teachers along the dimension of prior achievement, in the sense that higher and lower achieving students had equivalent odds of having a quality teacher. It is possible that school context or working conditions could explain some of the variability in the relationship between students' mathematics achievement and their odds of having a quality teacher.

Table 2.3 Odds Ratios from Within-School Models: Student Academic Background and the Likelihood of Having a Quality Teacher

	Model 1 Special Education		Model 2 Repeater		Model 3 High/Low math		Model 4 Math score	
Intercept	0.344	(0.195)	0.347	(0.195)	0.345	(0.194)	0.352	(0.176)
Special ed.	0.768	(0.122) *						
Repeater			0.833	(0.120)				
High math					1.025	(0.163)		
Low math					0.775	(0.157) ~		
Math score							1.106	(0.047) *
<i>Variance Components Table</i>								
Intercept	4.073	***	4.045	***	4.080	***	4.204	***
Math score							0.509	***
<i>Reliability</i>								
Intercept	0.849		0.848		0.849		0.842	
Math score							0.398	

~ p < 0.10 \* p < 0.05 \*\* p < 0.01 \*\*\* p < 0.001

In the full within-school model (in Table 2.4), I find that after controlling for differences in students' academic backgrounds, the relationship between racial background and the outcome is slightly attenuated. Black students and those classified as other race remain somewhat less likely than White student to have a quality teacher, but these relationships are only significant at  $p = 0.10$  compared to  $p = 0.05$  in the model that does not include academic background. Among the academic background variables, students with higher mathematics achievement are more likely than students with lower mathematics achievement to have a quality mathematics teacher. However, after controlling for all other student demographic and academic variables, the odds of having a quality mathematics teacher are not significantly different for special education students compared to non-special education students. Similarly, after controlling for all other student demographic and academic variables, students taking lower-level mathematics courses are no less likely than students taking mid-level mathematics courses to have a quality mathematics teacher.

Table 2.4 Odds Ratios from Full Within-School Model

	Odds Ratio	(SE)
Intercept	0.360	(0.176)
Female	1.018	(0.048)
Black	0.865	(0.082) ~
Hispanic	0.913	(0.070)
Asian	1.005	(0.166)
Other	0.848	(0.087) ~
SES	1.015	(0.029)
ELL	0.970	(0.142)
Special ed.	0.894	(0.109)
Repeater	0.932	(0.089)
High math	0.950	(0.149)
Low math	0.804	(0.138)
Math score	1.077	(0.039) ~

*Variance Components Table*

Intercept	4.148	***
Mathematics score	0.508	***

*Reliability*

Intercept	0.840
Mathematics score	0.397

~ p < 0.10 \* p < 0.05 \*\* p < 0.01 \*\*\* p < 0.001

The full within-school model explains approximately 25 percent of the variation in students' access to quality teachers.<sup>9</sup> Residual variances, shown at the bottom of Table 2.4, indicate that even with student-level statistical controls in the model, significant between-schools variability remained in the adjusted intercept as well as the mathematics achievement slope. This pattern suggests that school characteristics may be useful predictors of both the odds of having a quality teacher and the relationship between students' mathematics achievement and their odds of having a quality teacher.

<sup>9</sup> The proportion of variance explained is the difference between an unconditional level-1 model, which included regional and locale variables at level 2 but no predictors at level 1, and the within-school model controlling for student demographics and academic background. While region and locale were significant predictors of the outcome, they are not the focus of the study so the proportion of variance explained by within-schools model is net of the explanatory power of these variables.

### School context and students' access to quality teachers

Consistent with prior research, the descriptive results suggest that school context (i.e., aggregated socioeconomic status of students) is related to students' odds of having a quality high school mathematics teacher. Approximately 25 percent of students in public schools that fall into the lowest quintile of socioeconomic status had a teacher with such qualifications, while 44 percent of students in schools in the top quintile of SES had teachers meeting these qualifications. The multivariate findings regarding the relationship between school context and student access to quality teachers are presented in Table 2.5. Because the fixed effects for student-level variables change very little from the within-school models, they are not reported in the between-school models.<sup>10</sup> In this section I focus on the school-level effects on the intercept (odds of student having a quality teacher).

I find contextual effects for both racial and socioeconomic demographics on the odds of having a quality mathematics teacher, such that students in schools with a greater proportion of minority students and students in schools with lower average socioeconomic status are less likely to have a quality teacher compared to students in schools serving a whiter and wealthier populations. In terms of racial composition, the odds of having a quality mathematics teacher are 35 percent lower in schools serving a high proportion of non-White students compared to schools where more than half the student body is White. School social composition is also strongly related to the outcome, in that students in schools serving more affluent students were more likely to have a quality mathematics teacher. Specifically, for every standard deviation

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<sup>10</sup> In building the between-school model, I find one substantive change in the fixed effects among student-level variables: although Black students are less likely than White students to have a qualified teacher in the within-school model, the relationship between race and likelihood of having a qualified teacher is no longer significant when I control for school context.

increase in school average SES, a student’s odds of having a quality teacher increase by 1.27. In other words, compared to students in schools with average SES, ninth grade students in schools one standard deviation above average SES have nearly a 27 percent better odds of having a quality mathematics teacher. School average mathematics achievement among ninth graders is unrelated to students’ odds of having a quality mathematics teacher.

Table 2.5 Odds Ratios from Between-Schools Models: School Context and the Likelihood of Having a Quality Teacher

	Model 1 %Minority	Model 2 SES	Model 3 Math Achievement	Model 4 Full model
Intercept	1.139 (0.186)	0.383 (0.172)	0.356 (0.175)	0.434 (0.178)
High minority	0.653 (0.186) *			0.744 (0.199)
SES		1.267 (0.075) **		1.328 (0.142) *
Math achieve			1.113 (0.090)	0.883 (0.158)
<i>Variance components table</i>				
Intercept	4.040 ***	4.007 ***	4.124 ***	3.926 ***
Math score	0.504 ***	0.499 ***	0.503 ***	0.500 ***
<i>Reliability</i>				
Intercept	0.837	0.836	0.839	0.834
Math score	0.395	0.393	0.395	0.394

*Note.* School socioeconomic status is created by aggregating the socioeconomic status derived with locale from the student file, then standardizing the aggregated value so that the coefficient is in standard deviation units. High-minority schools are defined as schools with 45 percent or fewer White students, based on the aggregated proportion of students that identify as White.

~ p < 0.10

\* p < 0.05

\*\* p < 0.01

\*\*\* p < 0.001

In model 4, which controlled for all three features of schools, school average socioeconomic status retains a statistically significant relationship with the odds of having a quality teacher. That is, students in schools serving more socioeconomically advantaged students have greater odds of having a quality mathematics teacher. Controlling for socioeconomic status and average mathematics achievement, students in schools with a high proportion of minorities are no more or less likely to have a quality teacher compared to students in schools with fewer minorities. The change in between-school variance components (from the bottom of Tables 2.4

and 2.5) indicates that the model including all school context variables explained five percent of the between-school variation in students' access to quality teacher that remained after controlling for student characteristics.<sup>11</sup>

Working conditions and students' access to quality teachers

In Table 2.6, I present the descriptive statistics for school working conditions by average socioeconomic status. Consistent with theory and prior research, in most cases, working conditions were perceived more favorably in schools serving students from higher socioeconomic background than in schools serving socioeconomically disadvantaged students; the differences are statistically significant for all working conditions except for the percent of teachers who reported that teaching is not limited by lack of autonomy. The only exception is planning time: a greater proportion of mathematics teachers in low SES schools reported having adequate planning time relative to teachers in high SES schools ( $p < .001$ ).

Table 2.6 School Working Conditions by School Socioeconomic Status Quintile

	High SES	Low SES	
Principal support	0.13	-0.11	***
Resources & facilities	0.35	-0.12	***
Mathematics teacher expectations	0.42	0.03	***
Collective responsibility	0.48	-0.18	***
Collegial sharing	0.32	-0.24	***
Collegial support	0.22	-0.05	***
Planning time	46.85	53.97	***
Autonomy	60.17	62.35	
Student problems	-0.61	0.62	***
School climate (administrator perceptions)	-0.22	-0.37	***

*Note.* Descriptive statistics based on an unweighted sample size of approximately 710 schools. School socioeconomic status (SES) categories reflect the highest and lowest quintiles of the aggregated SES variable derived with locale. Descriptive statistics are weighted by NCES-created school weight, W1SCHOOL.

~  $p < 0.10$

\*  $p < 0.05$

\*\*  $p < 0.01$

\*\*\*  $p < 0.001$

<sup>11</sup> The proportion of variance explained is the difference between the full level-1 model, which included regional and locale variables at level 2, and the between-school model controlling for school contextual factors.

I present results that address research question three in Table 2.7. As seen in the results for Model 1, collegial support has a significant, positive main effect on students' access to quality teachers. Controlling for school context, being in a school in which teachers' collegial support is one standard deviation above the average increases the odds of having a quality teacher by 22 percent. While collegial support is positively associated with access to quality teachers, it does not mitigate the impact of school average socioeconomic status on students' odds of having a quality teacher.

Table 2.7 Odds Ratios from Between-Schools Models: Working Conditions and the Likelihood of Having a Quality Teacher

	Model 1: Collegial Support	Model 2: Expectations	Model 3: Student Problems
Intercept	0.411 (0.177)	0.405 (0.182)	0.413 (0.181)
High minority	0.745 (0.187)	0.719 (0.193) ~	0.808 (0.194)
School average SES	1.328 (0.134) *	1.325 (0.148) ~	1.309 (0.151) ~
School average math	0.867 (0.147)	0.889 (0.151)	0.813 (0.146)
Collegial support	1.220 (0.111) ~		
Expectations		1.245 (0.112) *	
Math*Expectations		0.833 (0.095) ~	
Student problems			0.786 (0.133) ~
Math*Student problems			1.168 (0.077) *
<i>Variance Component</i>			
Intercept	3.853 ***	3.847 ***	3.832 ***
<i>Reliability</i>			
Intercept	0.831	0.829	0.829

As seen in the results for Models 2 and 3 in Table 2.7, significant interactions exist between certain working conditions and school context. The significant interaction terms indicate that the effect of working conditions on the odds of having a quality teacher differed according to school average mathematics achievement in the fall of ninth grade. In other words,

school average mathematics achievement is a contextual factor that moderates the relationship between student problems and students' access to quality teachers. Mathematics teachers' expectations generally have a positive, significant relationship with students' access to quality teachers, and students' problems generally have a negative relationship with access to quality teachers, but both relationships are moderated by school average achievement.

I included Figure 2.2 to facilitate the substantive interpretation of numerical interaction terms from Table 6. To create Figure 2.2, I summed the main effects for the working condition (student problems) and the relevant interaction term (Aiken & West, 1991; Cohen et al., 2003), then transformed the log odds to probabilities. On the left side of the figure are schools with low average mathematics achievement. Students in low achievement schools have a greater probability of having a quality teacher if the school has a low level of student problems rather than a high level of student problems. Among schools with low achievement, high levels of student problems are associated with a 33 percent decrease in the odds of having a quality teacher relative to being in a school with low level of student problems. We see a similarly large difference in probability of having a quality teacher based on mathematics teachers' expectations. Students in schools with high expectations are far more likely to have a quality teacher relative to students in low-achieving schools where teachers have low expectations.

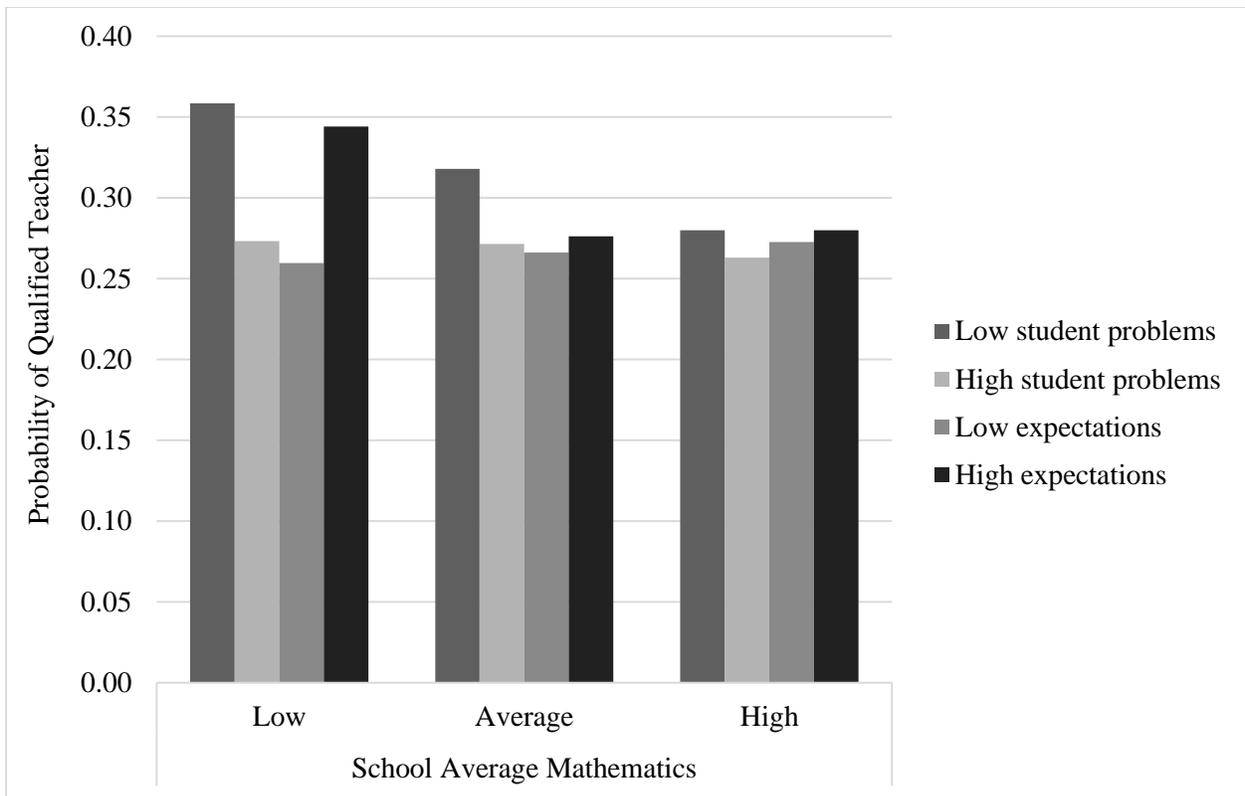


Figure 2.2. Differential relationship between student behavior and probability of having a quality mathematics teacher by average mathematics scores of ninth graders.

In schools with average achievement, students have a greater probability of having a quality teacher if their school has a low level of student problems. In average achievement schools, compared to students in schools with low levels of student problems, students in schools with high levels of student problems experience a 20 percent decrease in the odds of having a quality teacher. However, teacher expectations have little relationship to the probability of having a quality teachers in schools of average achievement. For schools with high average mathematics achievement (seen on the right), the odds of having a quality teacher are similar regardless of student problems and teacher expectations. These findings are consistent with prior research that suggests that working conditions may be of greater importance to teachers in more challenging school contexts.

I also find cross-level interactions in a slope-as-outcome model in which school context and working conditions moderated the relationship between a student's mathematics achievement and his or her odds of having a quality teacher. In developing the within-school model, I find that the relationship between a student's mathematics achievement in fall of ninth grade and his or her odds of having a quality teacher is positive and significant, but also that the relationship varied across schools. In the between-school model, cross-level interactions reveal that the relationship between students' mathematics achievement and odds of having a quality teacher is stronger in schools with higher levels of principal support, and weaker in schools with higher average achievement (based on ninth graders' fall mathematics scores). These two factors explain about seven percent of the variation across schools in the relationship between students' mathematics achievement and access to a quality teacher.

In Table 2.8, I present the findings of the final, fully conditional model. Although the coefficients are in the same direction, none of the working conditions have a significant main effect when controlling for other working conditions. For example, students in schools with higher levels of collegial support have better odds of having a quality teacher, but this relationship is no longer statistically significant once we control for expectations and student problems. The interactions between school average mathematics achievement and working conditions remain significant, and the cross-level interactions are also significant in the final model.

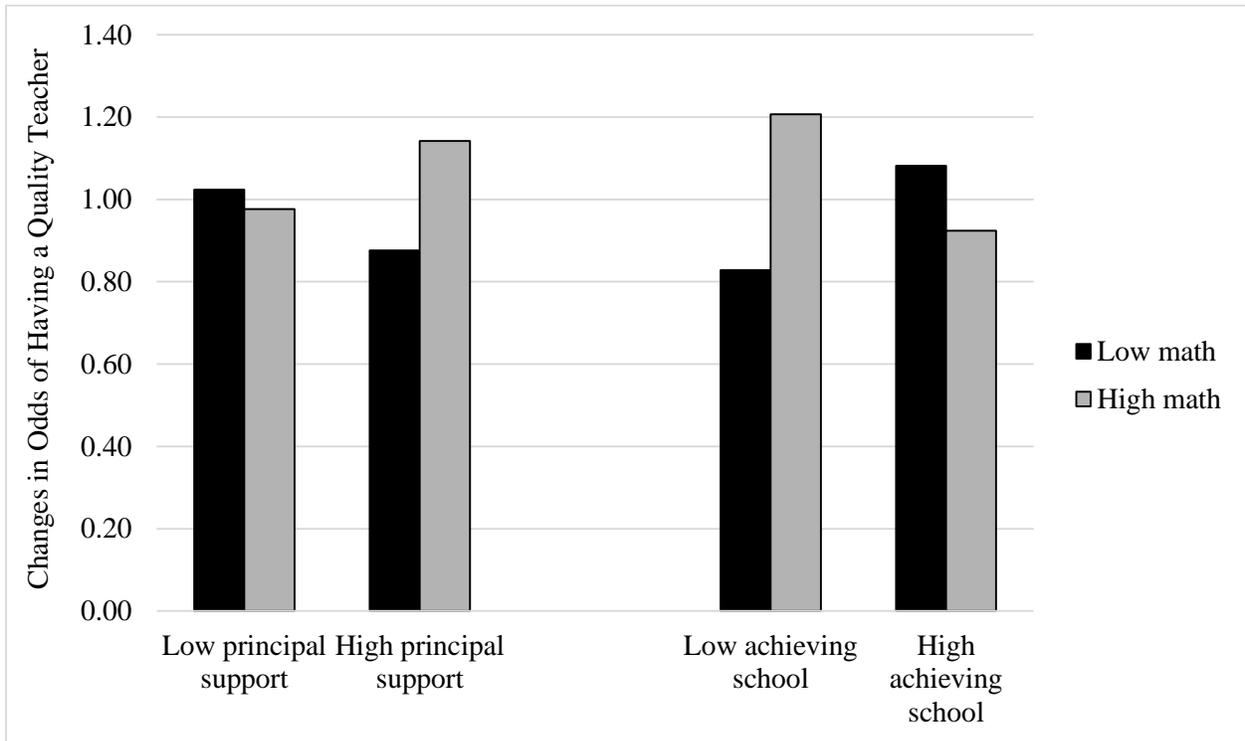
Table 2.8 Full Between-School Model Including Cross-level Interaction

	Odds Ratio	(SE)
Intercept	0.389	(0.183)
High minority	0.778	(0.191)
School average SES	1.326	(0.145) *
School average math	0.878	(0.140)
Collegial support	1.175	(0.112)
Expectations	1.140	(0.116)
Math*Expectations	0.857	(0.097) ~
Student problems	0.869	(0.128)
Math*Student problems	1.135	(0.076) ~
<i>Math score</i>		
Intercept	1.054	(0.038)
Principal support	1.071	(0.041) ~
School math	0.871	(0.042) *
<i>Variance Components</i>		
Intercept	3.770	***
Math score	0.469	***
<i>Reliability</i>		
Intercept	0.824	
Math score	0.382	

In Figure 2.3, I graphically display the cross-level interactions. The four bars on the left side of the figure show the change in odds of having a quality teacher associated with principal support. In schools where teachers perceived low levels of principal support, low- and high-achieving students have similar odds of having a quality teacher; the odds of having a quality teacher are five percent greater for low-achieving students than for high-achieving students. In schools with high levels of principal support, the odds of having a quality teacher are 23 percent greater for high-achieving students than for low-achieving students.

On the left side of Figure 2.3, I display the relationship between students' mathematics achievement and the odds of having a quality teacher as a function of school average achievement. In schools with low average achievement, the odds of having a quality teacher are 31 percent lower for low-achieving students compared to high-achieving students. In high-

achieving schools, the relationship between achievement and the odds of having a quality teacher was in the opposite direction, but less dramatic: compared to high-achieving students, low-achieving students' odds of having a quality teacher are 17 percent greater.



*Figure 2.3.* Cross-level interactions: variation in mathematics slope by principal support and school average mathematics achievement.

While in general, higher achievement is associated with greater odds of having a quality mathematics teacher, aspects of the school environment influence these odds. Here, we see that in schools in which teachers perceive the principal as more supportive, students with higher achievement have a greater probability of having a quality teacher relative to their lower-achieving peers. In schools in which teachers perceive the principal as less supportive, the relationship is in the opposite direction, though quite weak. In other words, in schools with lower perceived principal support, students' achievement is not strongly related to whether they have a quality teacher. If teachers view the opportunity to work with high-achieving students as

an appropriate practice to reward teachers with more experience, principals who provide such opportunities may be considered supportive. Because the definition of “quality” employed here includes teacher experience, such views might explain why high-achieving students have greater odds of having a quality teacher in schools with more positive perceptions of principal support. None of the other school contextual factors or working conditions had a significant impact on the relationship between students’ mathematics achievement and their odds of having a quality teacher.

### **Discussion**

This study is intended to build on prior work on teacher distribution and to shed light on the extent to which students have access to teachers with qualifications associated with student achievement. Despite various policy efforts of the past decade to ensure students equitable educational opportunities, inequity in student access to teachers with the types of qualifications that indicate effectiveness continues to occur both within schools along the dimension of student achievement and between schools as a function of school average socioeconomic status. On a more positive note, I find no significant evidence of disparities in access to quality high school mathematics teachers within schools along the dimensions of socioeconomic status, gender, or whether students had repeated a grade.

Consistent with prior work on the link between students’ academic backgrounds and teacher qualifications (e.g. Oakes, 1990; Kelly, 2004), students enrolled in lower-level mathematics courses are less likely to have teachers with qualifications that are associated with teacher effectiveness, although this relationship is not significant after controlling for students’ mathematics achievement. Also consistent with studies of assignment of students to teachers

(Feng, 2010; Kalogrides, Loeb & Béteille, 2011), higher-achieving students have greater access to quality teachers than their lower-achieving peers in the same school.

It is noteworthy that higher-achieving students have greater access even after accounting for the level of mathematics course being taken; this finding indicates that formal tracking of students into high and low level courses does not fully account for the positive matching (pairing of high-achieving students to quality teachers) observed here. Given that an increasing number of states and school districts have begun requiring algebra for all students in ninth grade, if not earlier (Nomi, 2012), one possibility is that some schools may have responded by creating homogeneously grouped algebra classes. Even students who are not formally tracked (placed in lower level course), may be informally tracked, so that some sections of algebra have more low achieving students and others have higher achieving students. The findings of this study suggest that quality teachers are more likely to teach those sections with higher achievers. However, one limitation of the current study is that such informal tracking is not directly observed.

Although positive matching may be considered a defensible practice to the extent that it maximizes student outcomes, Oakes (1990) found no empirical evidence to justify inequitable access to valued mathematics teachers. Thus, the inequitable access to quality teachers observed in these data may diminish the prospects of low-achieving ninth grade students catching up during their high school years. Cross-level interactions indicate that positive matching was especially strong in low-achieving schools. It is possible that school leaders in low-achieving schools use positive matching as a way to make the school more attractive to quality teachers or to retain high-achieving students. Alternatively, it is possible that positive matching actually contributes to low achievement. Although the current study cannot speak to which scenario is

more likely, other work has suggested that more effective schools provide more equitable class assignments (Loeb, Kalogrides, & Béteille, 2011).

Since most administrators have little discretion over teachers' salaries, they might choose to award teachers with desirable teaching assignments in an effort to retain favored teachers. I find that in schools in which teachers perceive principals as supportive, high-achieving students are more likely to have quality teachers than are low-achieving students; schools in which principals are perceived as less supportive do not exhibit this pattern. Such well-intentioned strategic assignment of teachers, which is a potential explanation for the results in this study, may inadvertently create inequity in access to educational resources for certain students. If the relationship between teacher quality and student achievement is stronger for low-achieving students, as Babu and Mendro (2003) found, assigning quality teachers to higher-achieving students will be an inefficient use of human capital resources. It may be difficult for individual administrators to give up offering high-quality teachers the "perk" of more advanced classes, since any administrator who chooses not to offer such perks risks losing teachers to nearby schools where preferences are honored. Thus, school district leaders and policymakers might look for ways to encourage schools to bolster low-achieving students' access to quality teachers.

Prior research indicated that the demographic composition of schools is associated with teacher retention and attrition (Hanushek, Rivkin & Kain, 2004; Ingersoll & Perda, 2010; Scafidi, Sjoquist & Stinebrikner, 2007), such that schools with greater proportions of minority, low-income, and low-achieving students have had higher rates of attrition. I find that students in schools with lower average socioeconomic status are less likely to have a quality mathematics teacher, which is consistent with what is suggested by prior research. However, in the current

study, neither average mathematics achievement nor high minority enrollment explains differences *between* schools in the odds of having a quality high school mathematics teacher after controlling for socioeconomic status. Among ninth grade public-school mathematics students, achievement and race appear related to students' odds of having a quality teacher mainly *within* schools, and the race relationship is not consistently significant. It is unclear whether the discrepancy between this study and previous research reflects changes in patterns of teacher attrition, differences in regional as opposed to national samples, or if perhaps schools serving high proportions of minority and low-achieving students do experience higher attrition but are able to find quality replacements.

A considerable literature on teacher retention has shed light on the types of working conditions teachers find desirable. This study sought to extend this knowledge base by exploring whether working conditions are associated with ninth grade students' access to mathematics teachers with qualifications indicative of teacher effectiveness. The findings of the current study are consistent with studies that have identified high expectations, support from colleagues, and student problems as salient elements of school working conditions when it comes to teachers' career decisions (Ingersoll & May, 2012; Johnson, Kraft & Papay, 2012). Student access to quality teachers is greater in schools where teachers perceive their colleagues as working together to coordinate course content and provide support to one another. In schools with low average ninth grade mathematics achievement, students are more likely to have quality teachers when teachers perceive their colleagues as having high standards and are less likely to have a quality teacher when teachers perceive serious problems with student absenteeism, class cutting apathy, and lack of parent involvement. Such working conditions may be amendable to policy solutions. Improving organizational conditions may better position schools to attract and retain

quality teachers (Ingersoll & May, 2012; Johnson, Kraft & Papay, 2012), and thereby improve students' educational opportunities.

While some working conditions exhibit expected relationships with student access to quality teachers, many other working conditions are not significant predictors, and working conditions explain little of the between-school variance in student access to quality teachers. These findings are somewhat unexpected. Other researchers have found that working conditions influence teacher retention, so I expected student access to quality teachers to be more consistently related to working conditions. Several potential explanations for this discrepancy exist. School working conditions such as resources and facilities may matter to teachers' sense of satisfaction, yet not play a strong role in career decisions. The relationship between working conditions and student access to quality teachers may be attenuated if teachers do not have access to information about working conditions, such as the extent to which staff take collective responsibility or teachers are granted autonomy, when making decisions about where to teach. It may be that leaders in schools with positive working conditions are not capitalizing on the potential to use those working conditions as a recruitment and retention tool, or that they are not strategically using working conditions to recruit and retain teachers with this particular set of characteristics. Another possibility is that quality mathematics teachers are responsive to a different set of factors than are teachers generally.

Although prior work by Loeb, Darling-Hammond and Luczak (2004), Grissom (2011), and Johnson, Kraft and Papay (2012) indicated that accounting for working conditions can reduce the observed relationship between school demographics and teacher turnover, I did not find evidence to suggest that stronger working conditions weaken the relationship between

school socioeconomic status and student access to quality teachers. Inequities in access to such teachers related to social stratification persist even after accounting for a variety of working conditions. Many potential explanations for this relationship exist: teachers may simply find wealthier students more desirable to work with, or they may prefer to work in a setting where students are more likely to be successful in school, since accountability pressure can create a stressful environment for teachers (Valli, Croninger, Chambliss, Graeber & Buese, 2008). Given that teachers prefer to work close to home (Reininger, 2012) and given the considerable socioeconomic segregation that exists in this country, teaching in a low-income community may be less desirable for teachers if doing so increases their commute time. Whatever the root cause, disparities in access to quality teachers that favor schools serving students of higher socioeconomic status exacerbate inequality in educational opportunity.

However, I did find that certain working conditions had a strong relationship with student access to quality teachers in low-achieving schools and little or no relationship with the outcome in high-achieving schools. As noted earlier, students in schools with low average ninth grade mathematics achievement have better odds of having a quality mathematics teacher if they are in a school in which teachers perceive their colleagues as having high standards. The extent to which teachers perceive serious problems with student absenteeism, class cutting apathy, and lack of parent involvement is most strongly related to students' odds of having a quality mathematics teachers in low-achieving schools; in high-achieving schools, student problems have little relationship to the probability of having a quality teacher. These findings are consistent with prior research that suggests that working conditions may be of greater importance to teachers in more challenging school contexts (Grissom, 2011).

This study has several limitations that affect the generalizability and validity of these conclusions. First, generalizability of this study is limited to ninth grade students attending public schools and enrolled mathematics courses in the United States. Students' access to high-quality middle school or elementary school teachers, or to high-quality high school teachers of different subjects, may exhibit different patterns than seen here. Secondly, it is possible that unobserved differences between students (such as behavior of individual students) or schools (such as salary differentials) may partially explain the observed relationships between the independent variables examined and students' access to quality high school mathematics teachers. Finally, because this analysis is a correlational study based on cross-sectional data, it is inappropriate to draw causal inferences from the results. Working conditions that are related to student access to quality teachers do not necessarily cause retention or attrition of such teachers.

Nevertheless, the current study provides valuable information about the relationships between student and school characteristics and public school students' access to quality high school mathematics teachers. These analyses make use of a nationally representative sample of ninth grade U.S. public school students as well as a methodology that is 1) appropriate given the nested nature of the data and 2) allows us to explore student access to quality teachers both within and across schools on a national level. While some prior studies employed nationally representative data (c.f. Ingersoll, 2001; Ingersoll & May, 2012) and others have looked at both within and across school sorting simultaneously (c.f. Clotfelter, Ladd, & Vigdor, 2006), one contribution of this study is that it combines the strengths of prior studies by exploring both within- and across-school sorting using nationally representative data.

In light of the differences in student access to quality teachers based on students' academic background, it would be helpful to explore whether the advantages of positive matching between students and teachers outweigh potentially negative consequences. It is also possible that low- and high-achieving students respond differently to teacher qualifications. Some students may benefit more from being paired with a teacher with a stronger pedagogical background, while other students may respond more to content knowledge regardless of a teacher's pedagogical strengths. Policymakers and school leaders could use such information to optimally match teachers to students to maximize outcomes for *all* students. In addition, given that students in low-income schools seem to be at a particular disadvantage with regard to equitable educational opportunities, future work might investigate policies that enable low-income schools to attract and retain quality teachers through improvements to the teachers' working conditions.

## Chapter 3: Are Working Conditions Related to Teacher Effectiveness?

### Introduction

Human capital – defined as the skills and knowledge that organizational members possess and can utilize in the realization of organizational goals (Rice & Croninger, 2005)–has gained attention as a particularly crucial resource in the effort to improve schools. Policy efforts to improve human capital abound, and include licensing requirements to set a floor for teacher skills and knowledge and financial incentives to attract and retain teachers with specific qualifications. The recent Race to the Top initiative shifted the focus from teacher qualifications to teacher effectiveness. This initiative and others encourage local education agencies to use multiple measures of teacher effectiveness, such as value-added estimates based on students' test scores, to guide human resource decisions around individual teachers.

While human capital is undoubtedly an important resource for school capacity, prior work suggests that various school resources interact, such that the productivity or development of one resource may depend on the availability of another resource. For example, in a study of schools facing accountability sanctions, Malen and Rice (2004) noted that a lack of discretionary funds (fiscal capital) limited the opportunity to develop cultural capital. Just as the capacity of a school to become more productive is determined in part by available resources (Malen & Rice, 2004; Rice & Croninger, 2005), the capacity of teachers in the school to be more effective may also be determined by available resources. Teachers may be more or less effective as a function of school working conditions that translate human capital into productive instructional practice.

Two aspects of school working conditions might be particularly relevant to teacher effectiveness: social capital and information resources. Policymakers have long relied on enhancements to information resources, including in-service training mechanisms such as

professional development and mentoring, as a means of augmenting the skills of the current teaching workforce. Both qualitative and quantitative studies have indicated that teacher's instructional practice and ability to achieve school goals may be influenced by aspects of a school's social organization (Bryk & Schneider, 2002; Rosenholtz, 1989) and forms of social capital in schools, which "characterizes an organization's capacity to motivate individuals to engage in collective actions" (Rice & Croninger, p. 76).

In this study, I conceive of informational resources and social capital as umbrella terms for various working conditions that have implications for teacher effectiveness. As noted in the introduction to this dissertation, working conditions are broadly conceived. Here, I focus on school leadership, professional development, collegial support, qualifications of colleagues, and data use as aspects of the school working conditions that the literature suggests may play a role in shaping teacher effectiveness. In the next section I describe this literature on working conditions and how these working conditions influence teachers' performance.

### **Review of the Literature on Teachers' Working Conditions and Teacher Effectiveness**

Several studies have shown that teachers' working conditions influence teachers' job satisfaction, retention, and school outcomes (Bryk & Schneider, 2002; Johnson & the Project on the Next Generation of Teachers, 2004; McLaughlin & Talbert, 2001; Rosenholtz, 1989). Researchers have examined fairly concrete aspects of working conditions, such as material resources and facilities (Johnson, Kraft, & Papay, 2011; Ladd, 2011; Loeb, Darling-Hammond, & Luczak, 2005), as well as the amount of professional development offered and time for planning and collaboration (Johnson, Kraft, & Papay, 2011; Ladd, 2011). Others have studied the qualifications and effectiveness of one's colleagues as workplace factors that might influence

teacher effectiveness via peer learning (Croninger, Rice, Rathbun, & Nishio, 2007; Jackson & Bruegmann, 2009).

Many of the relevant aspects of the school environment might be construed as types of social capital or informational resources within the school. Fukuyama (2001) described social capital as an “informal norm that promotes cooperation between individuals” (p. 7). According to Coleman (1988), forms of social capital include the obligations, expectations, and trustworthiness of social structures; information channels; and sanctions. Examples of social capital salient to teachers’ satisfaction and professional growth include teacher perceptions of school leadership (c.f. Boyd et al., 2011; Johnson, Berg, & Donaldson, 2005; Ladd, 2011), teacher collaboration and shared goals (Rosenholtz, 1989), relational trust (Bryk & Schneider, 2002), and school personnel’s shared meanings and patterns of behavior (Rinke & Valli, 2010). Informational resources, such as expert knowledge and the effectiveness of communication channels through which information travels, can also enhance an organization’s capacity to improve. Such resources are required if schools are to discontinue ineffective practices and achieve meaningful reforms. The review of the literature below explores the existing research on various aspects of teachers’ working conditions, all of which might be construed as forms of social capital and/or informational resources that could influence teachers’ effectiveness.

*Qualifications of Colleagues.* In both 1996 and 2001, teachers ranked “competent teacher colleagues/mentors” as the most important factor helping them in their work (NEA 2003, p. 73). Teachers might experience some “spillover” from working alongside high-quality colleagues when interacting and sharing ideas. Several studies support the notion that collective human capital matters. For example, using a national dataset Croninger, Rice, Rathbun and Nishio (2007) found a contextual effect of teacher qualifications, such that first grade teachers in

schools where their colleagues report specialized coursework have higher student gains in the area of specialization. The benefit appears to be passed on to the students of all teachers in the school, not just the students whose own teachers have specialized coursework. Croninger et al.'s finding suggests there may be peer effects on teachers as well as students. If teachers are interacting and learning from one another, it is reasonable that teachers whose colleagues have greater human capital will benefit from their peers' knowledge and skills.

Studies that show contextual effects associated with the effectiveness of colleagues are consistent with these findings. In an examination of longitudinal data on all students in grades three through five in North Carolina between 1995 and 2006, Jackson and Bruegmann (2009) found that students' test score gains were greater when their teachers' *colleagues* were more effective. Specifically, they found that teachers performed better when the quality of their peers improves within the same school over time. Again, these findings suggest peer learning took place among teachers within the same school. One implication of these findings is that an individual teacher's effectiveness might vary as a function of the effectiveness of his or her peers.

Leadership. Some research indicates that the quality of relationships between teachers and school leaders can influence school outcomes. Principals have considerable control over many aspects of teachers' working conditions, including assignment of students to teachers and the availability of instructional materials. In a mixed-method study that followed three schools in Chicago from 1994 to 1997 as staff undertook reform efforts, Bryk and Schneider (2002) found that teachers depend on principals for "procedural fairness in adjudicating competing interests among the faculty, a predictable environment governing basic school operations, adequate resources to conduct instruction, and professional support" (p. 29).

When principals convey a sense of procedural fairness through their actions, by providing what teachers perceive as adequate resources and professional support, they earn the trust of their teachers. This relational trust is a form of social capital that enables school leaders to motivate individual teachers to engage in collective actions (Rice & Croninger, 2005, p. 76). Under a social capital theory perspective:

these trust relations culminate in important consequences at the organizational level, including more effective decision making, enhanced social support for innovation, more efficient social control of adults' work, and an expanded moral authority to "go the extra mile" for the children (Bryk & Schneider, p. 22).

Thus, teachers' perceptions of school leadership may influence their willingness to put forth effort toward school-wide goals.

Rosenholtz (1989) also used a social organization framework and mixed-methods approach in her study of teachers in mostly rural elementary schools and how these teachers were influenced by school leadership. Specifically, her work illustrated that the extent to which principals establish collaborative norms and mobilize faculty resources can impact teachers' learning opportunities, defined as the "extent to which the social organization of schools poses restraints or opportunities for professional development" (Rosenholtz, 1989, p. 71). Teachers' learning opportunities, in turn, had a strong positive relationship with student achievement.

In recent studies, researchers have sought to determine a direct link between school leadership and student achievement. Ladd (2009) examined a 2006 survey of teachers in North Carolina and found that school leadership (a factor made up of items regarding overall quality of school leadership and efforts of leadership to address teacher concerns about facilities, resources, professional development and time) was the most salient factor in terms whether teachers departed from their school. In addition, school leadership had a significant and positive relationship with student achievement in mathematics. Based on a 2008 survey of teachers in

Massachusetts, Johnson, Kraft, and Papay (2011) demonstrated a significant relationship between teachers' ratings of school leadership (a factor incorporating ratings of whether school leadership shields teachers from disruptions, enforces rules for student conduct, gives teachers feedback and addresses teacher concerns) and school average growth in both mathematics and English language arts.

Qualitative work supports these quantitative findings. In Johnson's (2004) study of 50 novice teachers in Massachusetts over the course of four years, numerous teachers indicated a desire for support and feedback from their supervisors. One teacher summed up these sentiments by saying principals "have to know what you're doing and to see you in action, and to give you feedback, and to support you" (p. 102). When seeking better work settings, teachers looked for administrators who created structures of support and interaction among the school's teachers. In a qualitative study based on interviews of 13 participants in the Massachusetts Signing Bonus program, Liu, Johnson, and Peske (2004) found evidence that teachers' perceptions of their own success depended on whether they received adequate support and guidance from their principal and colleagues.

Blase and Blase (1999) analyzed responses to an open-ended questionnaire (completed by over 800 teachers) in which teachers were to describe the effect of principals' behaviors on classroom instruction. They found that teachers view instructional leaders who talk with teachers to promote reflection and promote professional growth as having a positive impact on classroom teaching. Principals who were seen as effective encouraged teachers to reflect on their practice by making suggestions, providing feedback, modeling strategies, using inquiry, and giving praise that reinforced effective teaching strategies. Teachers reported that such dialogue with their principal led them to reflect more and plan more carefully. In addition, effective

principals promoted professional growth by emphasizing the study of teaching and learning, supporting collaboration, developing coaching relationship, and applying principles of action research to inform instructional decision-making (Blase & Blase, 1999). Blase and Roberts (1994) drew on the same data to describe specific strategies principals use to influence teachers. They found that principal support and modeling of instructional strategies influenced teachers' motivation, awareness (i.e., recognizing the academic and social needs of students), and professional growth. Principal visibility (principals' willingness to spend substantial amounts of time in locations throughout the school and being available to teachers) was associated with increased instructional time on task in the classroom and principal suggestions were related to teacher reflection as well as classroom innovation and creativity (Blase & Roberts, 1994).

Based on a qualitative study of nine urban elementary schools serving low-income students, Youngs and King (2002) found that effective principals develop and sustain high levels of capacity among school staff. In one school, teachers credited the principal with creating an atmosphere in which the teachers constantly scrutinized their expectations and instructional practices—a practice similar to the reflection of teachers in the Blase and Blase (1999) study. In two of the four schools highlighted in the study, school leadership maintained a focus on learning goals, instituted a culture of trust and collaboration, and established time for teachers to reflect on their practice.

Thus, the body of work reviewed here suggests that school leadership plays a critical role in shaping teacher effectiveness in multiple ways. School leaders can foster effective teaching by establishing a clear focal point for teachers' work and developing relational trust, which enables school leaders to motivate individual teachers to engage in collective actions (Rice & Croninger, 2005). School leaders may also provide feedback and allocate time to allow for

reflection and collaboration, which may enhance teachers' instructional practice and ultimately, their ability to achieve school goals.

*Professional Development.* Professional development has long been seen as a means of improving human capital in schools. However, in a recent review of the literature, Yoon et al. (2007) found just nine studies that met What Works Clearinghouse standards for evidence. All nine studies involved elementary school students and teachers. Based on these studies, the authors concluded that “teachers who receive substantial professional development—an average of 49 hours in the nine studies—can boost their students' achievement by about 21 percentile points” (p. iii).

Some more recent studies confirm these positive findings. To explore the efficacy of an intervention focused on improving teacher-student interactions in the classroom via workshop training, video libraries and personalized coaching, Allen, Pianta, Gregory, Mikami, and Lun (2011) conducted a randomized control trial involving nearly 80 high school teachers and over 2,000 students. The authors found substantial gains in student achievement in the year following the completion of the intervention; structural equation models indicated that these gains were driven by changes in teachers' interactions with students, as measured by the Classroom Assessment Scoring System–Secondary (CLASS-S). Biancarosa, Bryk, and Dexter (2010) conducted a longitudinal study of a one-on-one teacher coaching model designed to improve student literacy learning. Using a hierarchical value-added-effects model to compare student literacy learning over three years, they found increasing improvements in student literacy learning during the implementation of the coaching program with standard effect sizes of .22, .37, and .43 in years one, two, and three, respectively.

Nonetheless, some other recent studies cast doubt on the efficacy of professional development. Garet et al. (2008) conducted a large-scale randomized field trial to examine the effectiveness of two different professional development interventions focused on second grade reading instruction in urban, high poverty settings. The professional development interventions had positive impacts on teacher's knowledge of scientifically based reading instruction and had a positive impact on one of the three instructional practices (explicit instruction) promoted by the professional development. However, teachers' use of the other two instructional practices targeted by the professional development—*independent student activity* and *differentiated instruction*—did not change as a result of the interventions; neither intervention resulted in significantly higher student test scores at the end of the one-year treatment. In a second study of middle school mathematics teachers, Garet et al. (2011) used an experimental design with random assignment of schools to explore the impact of a professional development program with over 100 contact hours planned for teachers who participated in both years of the study. In the first year, the program was delivered to approximately 100 teachers in 12 districts; in year two, approximately 50 treatment teachers in 6 districts participated. After two years of implementation, the program did not have a statistically significant impact on either teacher knowledge or student achievement in rational numbers.

Mixed results may be due to differences in what constitutes professional development and the context for professional development in studies. Drawing on research about professional development and learning, Hawley and Valli (2000) recommended that professional development be school-based, continuous, organized around collaborative problem solving. They further recommend that professional development should incorporate evaluation of multiple sources of information, including measures of teacher knowledge and practice as well as

outcomes for students. Qualitative studies suggest the wisdom of this view of professional development, which may encompass a more expansive range of activities than those that take place in formal workshops and coaching sessions. For example, in her study of teachers in Tennessee, Rosenholtz (1989) demonstrated that her broad construct of teachers' learning opportunities, which consists of shared goals, useful evaluations, and norms of collaboration, is related to student learning. Rosenholtz's learning opportunities construct is consistent with Hawley and Valli's (1998) conceptualization of professional development, which emphasizes the importance of evaluation and collaborative problem solving.

Collegial Support/Collaboration. As Rice (2009) points out, contemporary conceptualizations of what might be defined as professional development include allocation of time for common planning and supporting collaboration of teachers so they can learn from one another. Collegial support and collaboration, like leadership, may foster higher teacher retention, satisfaction, and effectiveness. As noted by Monk and King (1994), teachers may be able to increase their own effectiveness by drawing on the experience of and advice available from colleagues, if they have access to more capable teachers willing to help. A variety of studies have explored the extent to which school environments support professional growth. Building on social capital theory, Bryk and Schneider (2002) contend that "teachers need each other's help in carrying out the day-to-day routines of schooling" (p. 30). They also argued that cooperative relations among teachers are necessary to support coherent schoolwide instructional practices.

From semi-structured interviews with 105 teachers and 14 administrators, Little (1982) found variation in the extent to which schools' organizational characteristics are conducive to teachers' continued "learning on the job," and linked these norms of collegiality and continuous

improvement to aggregate school achievement. Teachers in higher-achieving schools pursued a greater range of collegial interactions, including talk about instruction, structured observation, and shared planning or preparation, than did teachers in lower-achieving schools. Little also noted that teachers in relatively high achieving schools engaged in these professional interactions with greater frequency, with a greater number and diversity of persons and in more locations than their counterparts in lower-achieving schools.

Theoretically, positive interactions among colleagues could improve teaching practice via the sharing of effective strategies and collaborative problem-solving. For example, Rosenholtz (1989) found that teacher collaboration is a significant positive predictor of teachers' learning opportunities. Rosenholtz revealed significant differences in progress on reforms between schools where teachers collaborated and those where they did not. These findings suggest that teacher collaboration may facilitate school-wide improvement.

While few studies have explicitly addressed the relationship between teacher collegiality and student outcomes, Johnson, Kraft, and Papay's (2011) study of teachers in Massachusetts revealed a significant relationship between ratings of working relationships with colleagues (which included having time to collaborate, solving problems together, and being provided opportunities to learn from one another) and school average growth in English language arts, though not mathematics. In linking student achievement data to a survey of teachers in North Carolina, Ladd (2009) found that teacher perceptions of whether they had sufficient time for collaboration predicted both mathematics and reading achievement of students in fourth and fifth grades.

Combined, the evidence on collegial support and quality of colleagues suggests not only that teachers can learn from their colleagues, but also that a variety of factors moderate the extent

to which teachers do so. Trust among colleagues and a shared sense of responsibility for student learning may facilitate productive working relationships; in short, the evidence suggests that having the opportunity to work with knowledgeable and effective colleagues benefits teachers and their students. Logically, the extent to which teachers have adequate time to collaborate might also moderate the extent to which teachers learn from one another. Unfortunately, the social structures of schools tend to limit opportunities for teachers to work together; teachers spend much of the day isolated from their colleagues (Bryk and Schneider, 2002; Elmore, 2004).

*Data Use and Strategic Decision-Making.* The past decade has seen a rise in the availability of student assessment data; increasingly, teachers are expected to use these data to improve student achievement. This expectation is reflected in recent education policies, such as Race to the Top. The theory of action underlying the push to use data is that doing so will enable teachers to make informed decisions about how to improve student achievement (Datnow, Park, & Kennedy-Lewis, 2012). Data analysis can help teachers identify areas of the curriculum that their students need to review, and provide guidance for instructional planning. Thus, it holds promise for more efficient and productive use of class time (Hamilton et al., 2009; Mandinach & Honey, 2008).

However, some evidence suggests that such analysis is still rare. Tyler (2011) examined the extent to which teachers in one mid-sized urban district logged onto a web-based, district-provided data tool. Based on information contained in the universe of web logs from the 2008-2009 and 2009-2010 school years, he found relatively low levels of teacher interaction with websites containing student test information that could potentially inform teaching practice. In Blase and Blase's (1999) study of effective instructional leadership, teachers reported that effective principals strove to implement action research to inform instructional decision-making,

but the authors found that principals' efforts in this regard were in their infancy and they found no strong effects on teachers. More recent research indicates that the principal plays a critical role in making data use a reality at the school and classroom levels (Cosner, 2011; Ikemoto & Marsh, 2007). The extent to which data-informed instruction is encouraged and teachers are given adequate support to make use of data are relatively unexplored aspects of teachers' working conditions that may influence teachers' effectiveness.

Little empirical work has specifically investigated the effectiveness of using data to improve student achievement. In the Institute of Education Sciences' practice guide on using data to support instructional decision making, the authors note that for all five recommendations made in the guide, the level of evidence is low by What Works Clearinghouse standards (Hamilton et al., 2009). While research on the efficacy of data use is limited, several qualitative case studies shed light on how data are being used and the importance of supports for data use. In one such qualitative case study, Datnow, Park, and Kennedy-Lewis (2012) found that the process of teachers' attempts to make sense of data and use this information to inform decision making is complex and influenced by social interactions within schools. The authors conclude that scheduling time for teachers to collaborate was essential for teachers to discuss data and plan together. In another, Blanc et al. (2010) concluded that interim assessments may contribute to instructional coherence and instructional improvement, but that to be effective such assessments must be embedded in a robust feedback system, and such feedback systems are rare.

### **Current Study**

Prior work has explored the relationship between social capital and informational resources—viewed here as elements of teachers' working conditions—and various outcomes, such as teacher turnover and sense of efficacy. Moreover, based on statewide data from

Massachusetts and North Carolina, some recent research has provided evidence of a direct link between working conditions and student achievement gains (Johnson, Kraft, & Papay, 2011; Ladd, 2009). In this study, I seek to extend the generalizability of these findings by exploring whether similar results hold in the context of New York City, the largest urban school district in the country.

Furthermore, while previous research links working conditions to school average achievement, we have little direct evidence of whether this link is due to enhanced teacher effectiveness. In this study, I focus on how working conditions might enhance or diminish teacher effectiveness as measured by teachers' value-added estimates. Following on the work of Ladd (2009) and Johnson, Kraft, and Papay (2011), I include measures of school context in an effort to disentangle the relative contributions of working conditions and school student body characteristics. I further hypothesize that school working conditions might have a stronger relationship in some contexts than others. It is possible, for example, that working conditions matter more in schools with more challenging contexts.

Finally, as Ladd (2009) notes, ideally it would be useful to compare teacher perceptions of school working conditions to the perceptions of external evaluators who use a protocol to conduct a "systematic evaluation of school working conditions" (p. 9). Although the New York City Department of Education (NYCDOE) does not have teacher and external ratings of the same constructs, NYCDOE does gather data on teacher perceptions of different aspects of school organization, such as collegial support and leadership, and external evaluators' ratings of school data use and strategic decision-making. Combining administrative data, data from the NYC School Survey, and data from the external evaluators gathered as part of the NYC Quality

Review, I am able to examine the relationship between working conditions and teacher effectiveness using multiple data sources.

The specific research questions guiding this study are as follows:

1. How much of the variation in teacher effectiveness is across schools?
2. Is school context related to teacher effectiveness?
3. Are teachers' working conditions, such as perceived support from administrators and professional learning opportunities, related to teacher effectiveness? Is the relationship between working conditions and teacher effectiveness moderated by school context?
4. Do school context and teachers' working conditions explain variation between schools in average teacher effectiveness?

The conceptual model (displayed in Figure 3.1) proposes that teacher effectiveness<sup>12</sup> is influenced by teachers' own skills, knowledge and background qualities, as seen on the right side of the model. Though observed or measurable skills and knowledge appear weakly related to effectiveness, prior research does suggest a link. For example, Rockoff, Jacob, Kane, and Staiger (2008) found a positive relationship between college selectivity and teacher effectiveness, and Clotfelter, Ladd, and Vigdor (2007) found a positive relationship between teacher licensure test scores and effectiveness. I do not explicitly model teachers' skills, knowledge, and background, but expect that these qualities are captured in estimates of teachers' effectiveness.

The boxes on the left side of the model depict the school-level variables of interest. The conceptual model also allows for the possibility that teacher effectiveness is influenced by school context. Arrow A represents the hypothesis that school contextual factors may influence teacher effectiveness and addresses the second research question. Arrow B is related to the third

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<sup>12</sup> A value-added measure of teacher effectiveness is generated using student reading/mathematics achievement data and a set of student control variables (prior test score, gender, race, SES, special education status, and English language learner status).

research question; the box linked to the outcome by Arrow B includes several aspects of teachers’ working conditions hypothesized to influence teachers’ ability to work effectively and thus to influence student achievement. These working conditions include *qualifications of colleagues, leadership, collegial support, professional development, and data use*. I anticipated that working conditions and school context are related to one another through a set of relationship captured by the double-headed arrow C. Appendix B provides a detailed list of the variables and constructs to be included in the study.

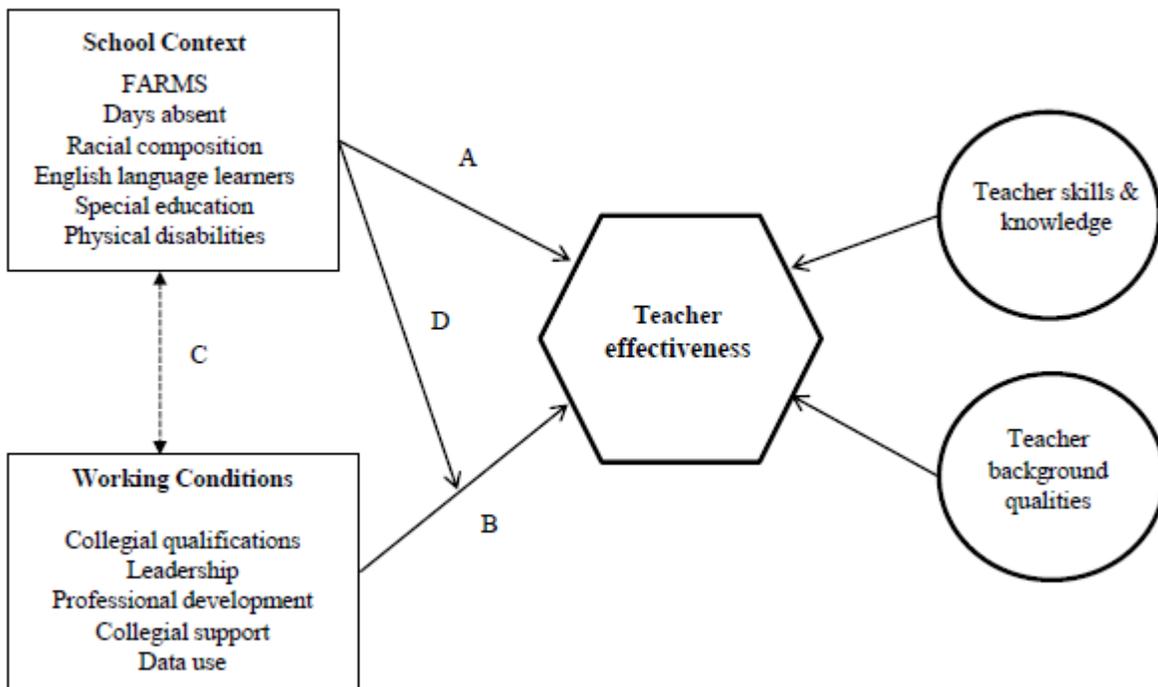


Figure 3.1: Multilevel heuristic model relating working conditions to teacher effectiveness.

**Data Sources**

For this study, I used administrative, survey, and Quality Review data from the NYCDOE. Though not a nationally representative sample, the NYC data have several advantages over other potential sources of data: it contains longitudinal data on students that can be linked to teachers, a prerequisite for the study proposed here. NYCDOE is the largest school

district in the United States; it serves approximately over a million students in nearly 1,700 schools in 2011-2012.<sup>13</sup> The student population is approximately 39 percent Hispanic, 29 percent African-American, 17 percent White, and 15 percent Asian/Pacific Islander. About 19 percent of the students have Individualized Education Programs (IEPs), and about 14 percent are English language learners (ELL).<sup>14</sup> NYCDOE has a higher proportion of students with IEPs and who are ELL relative to the proportion of such students in the state of New York as a whole.

Administrative data. The student data, provided by the NYCDOE, consist of data files for each year from 2006-2007 to 2010-2011 that contain student demographic and assessment information. Demographic files include measures of gender, ethnicity, language spoken at home, free-lunch status, special-education status, and days absent for each student who was active in any of grades three through five that year. For most years, the data include scores for approximately 65,000 to 80,000 students in each grade. Using these data, I constructed a set of records with a student's current exam score and his or her lagged exam score. For this purpose, a student is included when he or she had a score in a given subject (English language arts or mathematics) for the current year and a score for the same subject in the immediately preceding year for the immediately preceding grade. Following Boyd et al. (2008), I excluded cases in which a student took a test for the same grade two years in a row, or where a student skipped a grade, because these students would not have the same lagged exam scores as their peers.

I limited my sample to students in grades four and five from four cohorts of students (2006-2007 to 2009-2010).<sup>15</sup> Since it is more likely that classes are self-contained in elementary

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<sup>13</sup> Information obtained from the NYCDOE website, <http://schools.nyc.gov/AboutUs/data/stats/default.htm>.

<sup>14</sup> Percentages for race and IEP/ELL status are derived from information in the National Center for Education Statistic's Common Core of Data, "Local Education Agency Universe Survey," 2009-2010.

<sup>15</sup> Although NYC DOE provided data for 2010-2011, the teacher data office did not create a 2010-2011 file with student-teacher links, so data from this year were not used in the analysis (personal communication with M. Costa, 11/5/12).

than in middle school, a single teacher might reasonably be credited with both English language arts (ELA) and mathematics growth in elementary school. The vast majority of the students in the dataset have one teacher identifier. I can only estimate value-added for teachers of grade four or five because prior test scores are needed to estimate value-added, and the state assessments begin in third grade. I limited the analytic sample to students with a pretest score from the prior grade. Following Boyd et al. (2008), I required that teachers be linked to at least ten students to be included in the analysis because value-added estimates based on fewer students are likely to be quite imprecise (Atteberry, 2011). The teacher value-added scores were based on information from approximately 264,000 unique student records, and I created value-added estimates for 6,673 teachers in just over 700 schools.<sup>16</sup>

NYC School Survey. On an annual basis, the NYCDOE administers a School Survey to all parents and teachers. Survey results are intended to provide insight into a school's learning environment by gathering data on key stakeholders' perceptions of the schools' academic expectations, communication, engagement, and safety issues. I drew on these data to create composites from specific survey items, described in more detail in the section on Constructs and Measures. Similar to Ladd, I created the factors at the teacher level and limited the dataset to schools with students in grade four or five.<sup>17</sup> I then aggregated the mean of each factor to the school level. The measures of working conditions derived from this survey are types of informational resources and social capital which constitute "an aid in accounting for different outcomes at the level of individual actors" (Rice & Croninger, 2005, p. S101).

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<sup>16</sup> Because of missing data at the school level, actual analyses are based on the 6,384 teachers who teach in schools with data on the School Survey and Quality Review.

<sup>17</sup> I limited the data to schools with students in fourth or fifth grade because in conducting factor analysis on North Carolina data, Ladd (2009) found some differences in the items that loaded on factor scores across elementary, middle and high schools.

Quality Review. The Quality Review consists of a multi-day school visit by experienced educators to each New York City school; the school visit cumulates in a report intended to provide evidence-based information about the school and feedback to school leaders regarding school support for student performance. These external evaluators observe classrooms and talk to school leaders, then complete a rubric with a four-point scale indicating the extent to which the school has specific practices in place.

The Quality Review focuses on the coherence of a school's systems, measuring how well it is organized to meet the needs of its students and adults, as well as monitor and improve its instructional and assessment practices.

<http://schools.nyc.gov/Accountability/tools/review/default.htm>

I used the information from the Quality Review to create five factor scores, representing each of the quality statements on the rubric.<sup>18</sup> The five quality statements headings are 1) instructional and organizational coherence, 2) gather and analyze data, 3) plan and set goals, 4) align capacity building, and 5) monitor and revise. The items making up the factor scores are described in more detail in the section on Measures.

### Measures

The conceptual model proposed for this study incorporates a measure of teacher effectiveness, based on average test score gains, for the outcome variable, as well as working conditions (including leadership, professional development, collegial support, collegial qualifications, and data use), and school contextual variables (proportion of students eligible for Free or Reduced Priced Meals (FARMs), indicators of racial demographics, average number of days students are absent, and indicators regarding proportions of students who are English language learners, enrolled in special education, or physically disabled). Appendix B provides

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<sup>18</sup> As with the School Survey data, I limit the dataset to schools with fourth or fifth grade teachers prior to creating factor scores.

more detail on the measures used to represent the working conditions, including the specific items that comprise each construct and indicators of reliability.

To create a measure of teacher effectiveness, I used a statistical model that attempts to isolate a teacher's contribution to students' gains in academic achievement. While improved academic achievement is just one of many goals of schools, it often forms the basis for such "value-added" measures of teacher effectiveness. In theory, a teacher's value-added estimate represents "the unique contribution she makes to her students' academic progress" (Corcoran, 2010, p. 4). Although this is an admittedly narrow view of what constitutes successful teaching, as a practical matter, measures of student achievement in academic subjects tend to be more readily available than are measures of students' social and civic development. Furthermore, performance on such assessments is an indicator of students' literacy and numeracy skills, and improving the cognitive skills of individuals prior to entering the workforce has dramatic implications both for the future of the individual students and for the nation's economic growth (Hanushek, Jamison, Jamison, & Woessmann, 2008). For the purpose of this study, I use the term "teacher effectiveness" as shorthand for this "value-added" concept of successful teaching.

Elementary school students in New York State take yearly state assessments in core academic subjects (specifically, English language arts and mathematics) to assess their mastery of New York State Learning Standards. Reliability of the state assessments ranged from 0.83 for the fifth grade English language arts assessment to 0.94 for the fourth grade mathematics assessment. Student performance on state assessments in English language arts and mathematics are used to create the measure of teacher effectiveness. The construction of the measure of teacher effectiveness will be described more fully in the methodology section that follows.

From the administrative dataset, I also obtained measures of student demographics, including whether the student is eligible for Free or Reduced Priced Meals (FARMS), racial/ethnic group, number of days absent, whether the student was an English language learners, enrolled in special education, or physically disabled. I used these variables in the construction of teacher effectiveness measures as described in the next section. I also aggregated these variables to the school level to use as contextual variables. Because the proportion of minority students, English language learners, special education students, and students with physical disabilities are non-normally distributed, I created dichotomous indicators of whether the school had higher-than-average proportions of these students.<sup>19</sup>

The administrative data set provided information regarding teachers' years of experience. In this study, I used teacher experience as both a teacher-level variable and as a school-level aggregate that served as a proxy for the qualifications of colleagues. At the teacher level, I used a dichotomous indicator of whether the teacher has three or more years of experience on average across the school years included in the study (2007-2008 through 2009-2010); approximately 74 percent of teachers in this dataset are non-novices. I then aggregated this variable to the school level to create a continuous indicator of the proportion of teachers in the school with 3 or more years of experience. Because the aggregated variable is not normally distributed (in a large number of schools, all teachers have three or more years of experience), I created two categorical variables: one representing low average experience of teachers (if less than 70 percent had three or more years of experience) and another representing high average experience of teachers (if 85 percent or more had three or more years of experience). These measures may be thought of as a

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<sup>19</sup> For proportion of minority students, 90% or greater is above average; for English language learners and special education, 12% or greater is above average; for proportion of students with physical disabilities, 3% or greater is above average.

form of human capital (at the individual level) and an informational resource (at the aggregate school level) in the sense that teachers with some experience may share what they have learned over time with their colleagues.

I used data from the School Survey to create a scale indicating teachers' perceptions of support from school leaders, with higher values representing greater perceived support. I created this variable through principal components factor analysis of 15 items (see Appendix B for details) and standardized to a mean of 0 and standard deviation of 1. A representative item from the leadership scale is whether "school leaders visit classrooms to observe the quality of teaching at this school," which teachers rated along a four-point continuum of strongly agree to strongly disagree. The coefficient of reliability (alpha) was 0.96.<sup>20</sup>

A primary information resource for teachers to draw on to improve their human capital is professional development, particularly high-quality professional development. I drew teachers' perceptions of the quality of professional development from the School Survey to create a factor score of professional development quality; higher values represented greater perceived quality. I created this variable through principal components factor analysis of three items (see Appendix B for details) standardized to a mean of 0 and standard deviation of 1. A representative item is "The professional development I received this year provided me with teaching strategies to better meet the needs of my students," which teachers rated along a four-point continuum of strongly agree to strongly disagree. The coefficient of reliability (alpha) ranged from 0.89 to 0.90.

Support from colleagues may be another important form of social capital for teachers. I employed data from the School Survey to create a scale indicating teachers' perceptions of

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<sup>20</sup> I created separate factor scores for each year of survey data from 2007-2008 to 2009-2010. The Cronbach's alpha provided is the range across years for the scores created at the teacher level; in cases where alpha was stable across all three years, I report a single alpha. Factor scores were then aggregated to the school level. When item scores are aggregated to the school level, reliability is slightly higher.

support from their colleagues; higher values represented greater perceived support. I created this variable through principal components factor analysis of five items (see Appendix B for details) and standardized to a mean of 0 and standard deviation of 1. A representative item is “Most teachers in my school work together on teams to improve their instructional practice,” which teachers rated along a four-point continuum of strongly agree to strongly disagree. The coefficient of reliability (alpha) was 0.88.

As seen in Figure 3.2 below, the aggregate factors are normally distributed; the distribution suggests meaningful differences in the quality of working conditions across New York City public schools. Figure 3.2 provides evidence that the factors capture potentially meaningful variance across schools that may be associated with teachers’ value-added scores as based on the two achievement tests.

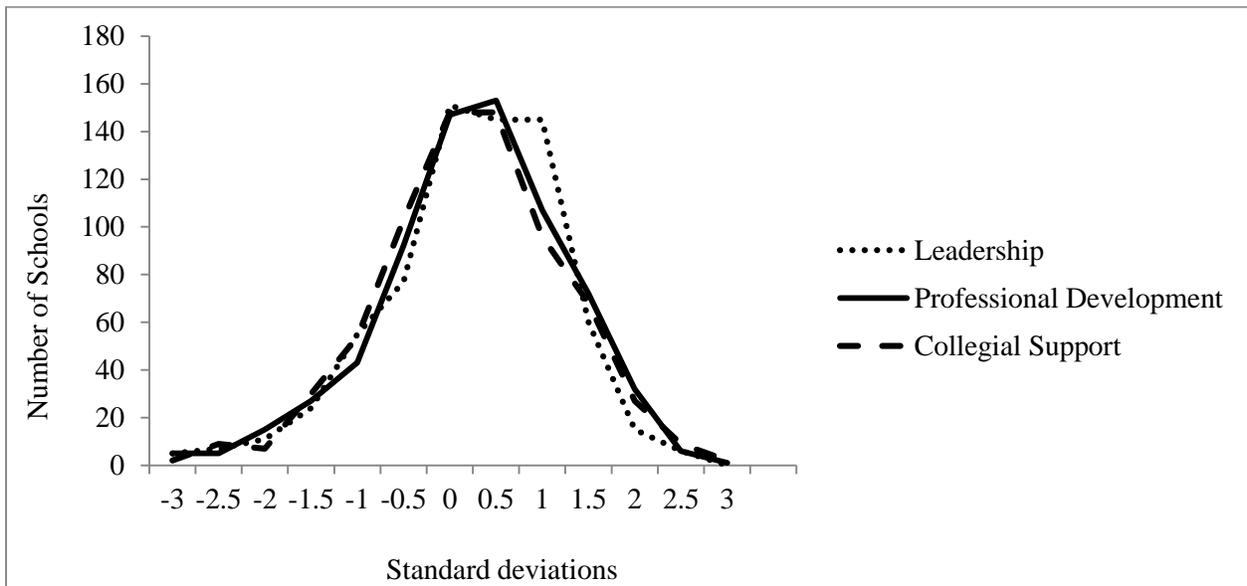


Figure 3.2. Distributions of teachers’ perceptions of leadership, professional development, and collegial support.

Compilation of data alone is unlikely to foster teacher or school improvement, but analyzing and interpreting data can help school staff identify effective and ineffective practices and may function as an important information resource in the quest for progress. I drew on

information from the Quality Review to devise scales indicating the external reviewers' perceptions of the school's data use and strategic decision-making. Because the Quality Review has five quality statements, each representing a different focus, I created five scales. I produced all five scales through principal components factor analysis of four items each (see Appendix B for details on the items), which external reviewers had rated along a four-point continuum ranging from "underdeveloped" to "well developed." This analysis resulted in standardized five factor scores (with a mean of 0 and standard deviation of 1). Each of the factor scores was normally distributed.

The first scale explores the extent to which the school has an articulate strategy to support student learning that aligns decisions regarding curriculum, instruction, and organization. A sample indicator looks at whether the school makes "strategic organizational decisions to support the school's instructional goals and meet student learning needs." The coefficient of reliability (alpha) is 0.82.

The scale representing the extent to which school staff gather and analyze data was comprised of ratings of the school's consistency in gathering, analyzing and sharing information on student learning outcomes to understand school and student progress over time. One item explores whether schools "align assessments to curriculum, use on-going assessment practices, and analyze information on student learning outcomes to adjust instructional decisions at the team and classroom level." The coefficient of reliability (alpha) ranged is 0.82.

Under the third quality statement, external reviewers rated schools leaders and faculty on the extent to which they consistently engage the school community and use data to set and track suitably high goals for accelerating student learning. A representing item from this scale is the extent to which the school has "a coherent vision of future development that is reflected in a

short list of focused, data-based goals that are understood and supported by the entire school community.” The coefficient of reliability (alpha) is 0.79.

The fourth scale consists of items regarding the extent to which the school aligned its leadership development and structured professional collaboration around meeting the school’s goals and student learning and emotional needs. A representative item from the scale is whether schools “use the observation of classroom teaching and the analysis of learning outcomes to elevate school-wide instructional practices and implement strategies that promote professional growth and reflection.” The coefficient of reliability (alpha) ranged from 0.48 to 0.85.

The final quality statement looked at the school’s structures for monitoring and evaluating progress throughout the year and for flexibly revising plans and practices to meet its goals for accelerating learning. A representative item from the scale is the extent to which staff “use data to regularly evaluate the effectiveness of structured professional collaboration, capacity building and leadership development strategies.” The coefficient of reliability (alpha) is 0.89.

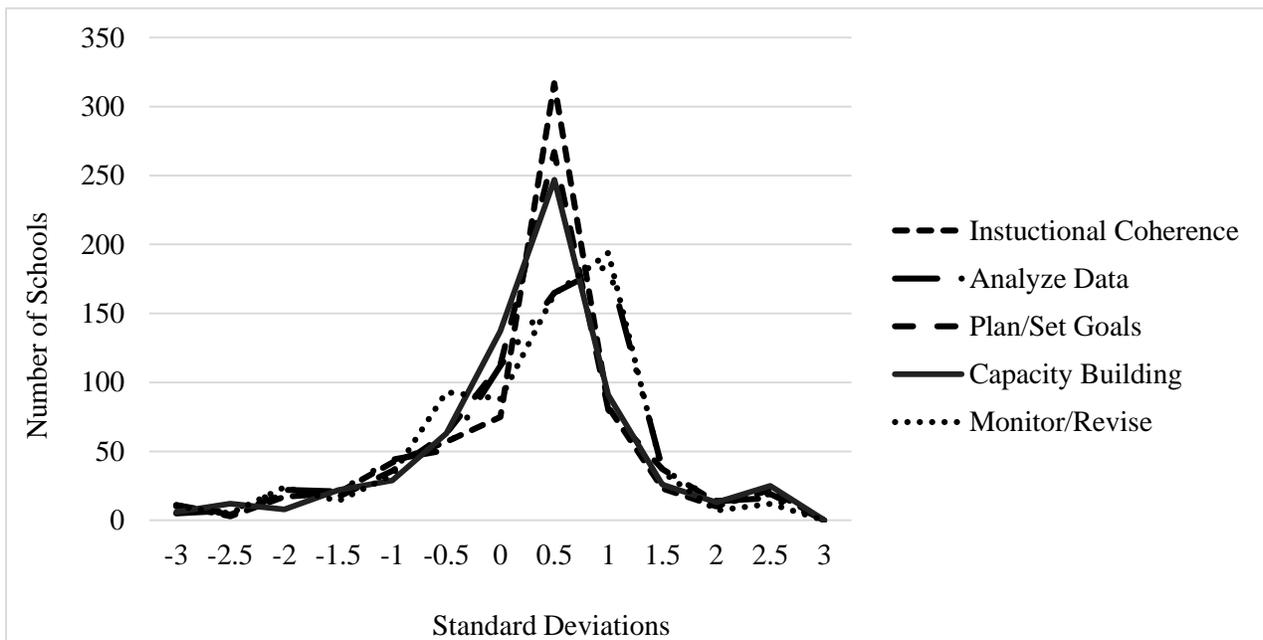


Figure 3.3. Distributions of external reviewers’ ratings regarding school data use and strategic decision-making.

In Figure 3.3, I present the distribution of five different standardized factor scores based on external reviewers' ratings of how well the school is organized to support student achievement via data use and strategic decision-making. As seen in the figure, the factors are normally distributed. The distribution suggests meaningful differences in the extent to which New York City public schools exhibit instructional and organizational coherence, gather and analyze data, plan and set goals, build capacity, and monitor plans and revise as needed.

### **Analytic Approach**

The analytic approach involved a multilevel framework, which recognizes the nested structure of students within classrooms within schools (Raudenbush & Bryk, 2002). I created the outcome using a multilevel model that nests students within classrooms, and address the research questions using multilevel models that nest teachers within schools. Multilevel models overcome several limitations of previous school effects research. Single-unit approaches (i.e. using the school or student as the unit of analysis) limit what the researcher can examine and require untenable assumptions, such as the assumption of independence of observations that is basis of many statistical techniques. As it applies to the research questions, a single-unit approach that focuses on school-level analyses requires the researcher to ignore variability in the both the outcome and in independent variables across teachers, and may introduce aggregation bias into the models. A single-unit approach that focuses on teacher-level analyses may lead to under estimation of standard errors and under estimation of school effects.

Prior to carrying out the multilevel analyses, I calculated population estimates of the means of continuous variables and percentages for categorical variables in SPSS for each of the

dependent and independent variables included in the analyses. I used ANOVAs to test for statistically significant differences in working conditions between schools in the highest and lowest quintiles of students eligible for FARMs. Results from the descriptive analyses indicated the degree to which teachers experience differential working conditions as a function of school context.

To create an estimate of teacher effectiveness, or value-added estimates, I used an approach prevalent in the literature (Aaronson, Barrow, & Sander, 2007; Goldhaber & Hansen, 2010; Koedel & Betts, 2011) that employs longitudinal test score data linked to teachers and schools (Schochet & Chiang, 2010). While some note such estimates may be biased as a result of nonrandom assignment of students to teachers (Rothstein, 2010), others note that observing teachers over multiple time periods mitigates this bias (Koedel & Betts, 2011). In this analysis I average up to three years of teachers' value-added estimates. Furthermore, I did not attempt to distinguish the effectiveness of individual teachers, but rather compared average teacher effectiveness across different schools. The bias in teacher effectiveness estimates that arises from nonrandom sorting of students to teachers within schools should not invalidate estimates of teacher effectiveness across schools.

To generate estimates of teacher effectiveness, I use current student achievement as the outcome in the models with lagged achievement scores in both the same subject and the opposite subject included as controls. In equation 3.1a below, *prior achievement* represents the vector of prior achievement scores (same subject and opposite subject). I standardized all student achievement scores within grade and year to have a mean of 0 and a standard deviation of 1.<sup>21</sup> I

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<sup>21</sup> This is consistent with the approach described by the Value-Added Research Center in their report, NYC Teacher Data Initiative: Technical Report on the NYC Value-Added Model (2010).

also include in the level-1 model represented by equation 3.1a a vector of controls for *student background*, including students' gender and ethnic background, whether the student was eligible for Free or Reduced Price Meals (FARMS), number of days the student was absent, English language learner status, special education status, and whether the student had a physical disability.

$$Y_{it} = \beta_{0t} + \beta_{1t}(\text{prior achievement}) + \beta_{2t}(\text{student background}) + r_{it} \quad [3.1a]$$

$$\beta_{0t} = \gamma_{00} + \gamma_{01}(\text{classroom aggregates}) + u_{0t} \quad [3.1b]$$

In addition to controlling for these variables at the student level, I included classroom-level aggregates in the level-2 model to mitigate concerns about peer effects and bias related to systematic sorting of teachers to students. Following Atteberry, Loeb, and Wyckoff (2011), I include aggregates of all individual-level characteristics, plus the standard deviation of prior year achievement as a measure of the heterogeneity of student achievement in a classroom. I fit this model separately for each grade and year combination; thus, teachers have value-added estimates from up to three years (2007-2008, 2008-2009, and 2009-2010). I then saved the residuals from this equation as estimates of a teacher's ability to stimulate test score gains relative to other teachers of the same grade in the same year. I used these measures serve as a proxy of teacher effectiveness. I average the estimates of effectiveness across the three years and standardized prior to analysis. The standardized average effectiveness estimates were approximately normally distributed.<sup>22</sup>

To address the research questions, I conducted a series of multilevel analyses. I used HLM 6 software and full maximum likelihood estimation to investigate the influence of aggregate teacher experience, school context, and teachers' working conditions on average

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<sup>22</sup> Although there was no evidence of skew, the outcomes exhibit some kurtosis: 4.463 for English language arts and 2.519 for mathematics.

teacher effectiveness. To address whether average teacher effectiveness varies across schools, I estimated a fully unconditional two-level model where teachers are nested within schools. Here, the level-1 model specifies effectiveness  $Y$  of teacher  $t$  in school  $j$  as a function of  $\beta_{0j}$ , which is the average teacher effectiveness for the  $j$ th school, plus some error. In the level-2 model,  $\gamma_{00}$  represents the grand-mean teacher effectiveness in the population, and  $u_{0j}$  is the random effect associated with school  $j$ , which is assumed to have a mean of 0 and a variance  $\tau_{00}$ .

$$Y_{tj} = \beta_{00} + r_{0tj} \quad [3.2a]$$

$$\beta_{0j} = \gamma_{00} + u_{0j} \quad [3.2b]$$

The unconditional model allows me to partition the variance in teacher effectiveness to variation within schools ( $r_{0tj}$ ) and between schools ( $u_{00j}$ ) (Raudenbush & Bryk, 2002). This information can be used to calculate the proportion of variance that occurs between schools (Raudenbush & Bryk, 2002). This proportion is calculated as:

$$\frac{\tau_{00}}{\sigma^2 + \tau_{00}} \quad [3.3]$$

The proportion of variance in teacher value-added scores that occurs between schools provides an estimate of the potential explanatory power of school characteristics on teacher effectiveness. The higher the proportion of variance attributable to schools, the more important school-level factors are in explaining teachers' effectiveness.

Research suggests that experienced teachers are, in general, more effective than novice teachers (Clotfelter, Ladd, & Vigdor, 2006; Rivkin, Hanushek, & Kain, 2005; Rockoff, 2004). To control for differences across schools in the proportion of experienced teachers and better

isolate the impact of school context and working conditions on teacher effectiveness, I adapted equation 3.2a by adding a grand-mean centered indicator of the teacher's years of experience.

$$Y_{tj} = \beta_{00} + \beta_{01j}(\textit{experience}) + r_{0tj} \quad [3.4a]$$

$$\beta_{0j} = \gamma_{00} + u_{0j} \quad [3.4b]$$

Then, to address the second research question regarding whether school supports for teachers such as perceived support from school leadership and collegial support are related to teacher effectiveness, I expanded on the school-level equation described above to examine the effects of various indicators of teachers' working conditions on teachers' effectiveness.<sup>23</sup> At level 2, I modeled the average teacher effectiveness in school  $j$  as a function of working conditions derived from the survey and Quality Review (leadership, professional development, collegial support, data use) as well as aggregated experience of teachers and aggregate characteristics of students in the school ( $W_{sj}$ ) and random school error ( $u_{0j}$ ):

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\textit{Context})_j + \gamma_{02}(\textit{Veteran})_j + \gamma_{03}(\textit{Survey})_j + \gamma_{04}(\textit{Quality Review})_j + u_{0j} \quad [3.5]$$

Where  $\beta_{0j}$  is the average effectiveness of teachers in school  $j$ ;  $\gamma_{00}$  is the average teacher effectiveness across all schools;  $\textit{Context}$  is a vector of school aggregates of student characteristics;  $\textit{Veteran}$  is a vector of dichotomous indicators of whether the school has a relatively high or relatively low proportion of veteran teachers;  $\textit{Survey}$  is a vector of factor scores drawn from the school survey, which capture teacher perceptions of the quality of leadership, professional development, and collegial support;  $\textit{Quality Review}$  is a vector of factor

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<sup>23</sup> To ensure that the model is correctly specified, I also checked whether teacher experience should be estimated as randomly varying across the level-2 units or estimated as fixed across level-2 units.

scores representing the various factors associated with the Quality Review ratings of school data use and strategic decision-making;  $\gamma_{0s}$  are the level-2 coefficients indicating the direction and strength of association between the working conditions and average effectiveness; and  $u_{ij}$  is the school-level random error or unique effect of school  $j$  (the deviation of the school's level-2 coefficient from its predicted score). Thus, the level-2 model allows for the exploration of the relationship between teachers' effectiveness and a series of working conditions. In the level-2 models, I entered dichotomous variables uncentered and continuous variables grand-centered.

Finally, I explored whether the relationship between teachers' working conditions and average teacher effectiveness is contingent upon school context. In other words, I investigated whether working conditions are more strongly related to teacher effectiveness in some school environments than others. Specifically, I created interaction terms between each of the working conditions and the proportion of students eligible for FARMS, to assess whether working conditions differentially influence teachers in schools serving more or less advantaged students.

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(FARMS)_j + \gamma_{02}(Working\ Condition)_j + \gamma_{03}(FARMS * WC)_j + u_{0j} \quad [3.6]$$

Where  $\beta_{0j}$  is the average effectiveness of teachers in school  $j$ ;  $\gamma_{00}$  is the average teacher effectiveness across all schools;  $FARMS$  is the proportion of student eligible for free or reduced price meals,  $Working\ Condition$  represents any one of the constructs from the survey or quality review, and  $FARMS*WC$  is the product of the proportion of students eligible for free or reduced price meals and the working condition in question. As with the other equations,  $\gamma_{0s}$  are the level-2 coefficients indicating the direction and strength of association between the covariates and average effectiveness; and  $u_{ij}$  is the school-level random error or unique effect of school  $j$ .

I examined the proportion of variance across schools explained by each model. By comparing the proportion of variance across schools in the fully unconditional model to the proportion of variance across schools in the model that includes an indicator of teacher experience, I can obtain an estimate of the proportion of between-school variance in average teacher effectiveness that is a result of differences across schools in the experience level of their teachers. The equation for determining the proportion of within-school variation explained is:

$$\tau_{Model1} - \tau_{Model2} / \tau_{Model1} \quad [3.7]$$

Where  $\tau_{Model1}$  is the between-school variation in teachers' effectiveness in the model that does not include teacher experience at level 2, and  $\tau_{Model2}$  is the between-school variation in teachers' value-added scores that remains after accounting for differences across schools in the experience of teachers in each school. Model 2 then becomes the baseline for determining the proportion of variance explained by models that include school context. That is, I estimate the proportion of between-school variance explained by school context using essentially equation 3.7, but comparing model 2 to the models with school context. This calculation provides an estimate of the ability of school context to explain variation in teachers' effectiveness over and above the variation explained by differences in teacher experience. To obtain the proportion of variance explained by working conditions, I compare the variance components of the model with school contextual variables to the variance of models that include working conditions.

### **Results**

In Table 3.1, I present the average teacher effectiveness in the first panel, school contextual variables in the second panel, and school working conditions in the third panel. I provide means and standard deviations for continuous variables and percentages for dichotomous variables. I present descriptive statistics for all cases, for schools in the lowest quintile of free

and reduced price meals (FARMS) enrollment, and for schools in the highest quintile of free and reduced price meals enrollment. The final column presents the results of statistical tests that compare differences in means or percentages for the latter two columns.

Teachers in the poorest (high FARMS) schools are significantly less effective in mathematics, though differences in English language arts are not significant. Regarding school context, by definition wealthier schools have fewer FARMS students (34 percent) than poorer schools (89 percent). School average days absent is greater in the poorest schools compared to the wealthiest schools. Compared to the wealthiest schools, the poorest schools have a higher proportion of English language learners, minority students, and students eligible for special education services. The proportion of students who are physically disabled is not significantly different between schools with more and less advantaged students.

Table 3.1 Descriptive Statistics of Outcomes and Predictors from Final Analytic Sample

	Full Sample		Means by Percent Free and Reduced Price Meals (FARMS)				
	<i>Mean</i>	<i>(SD)</i>	Low FARMS		High FARMS		<i>Sig</i>
			<i>Mean</i>	<i>(SD)</i>	<i>Mean</i>	<i>(SD)</i>	
<i>Panel I: Outcomes</i>							
VA ELA	-0.01	(0.14)	0.01	(0.07)	0.00	(0.06)	
VA Mathematics	-0.02	(0.25)	0.03	(0.14)	-0.04	(0.12)	***
<i>Panel II: School Context</i>							
Days absent	11.12	(2.04)	9.67	(1.90)	12.59	(1.68)	***
%FARMS	62.24		34.09		88.59		***
%Minority	85.51		73.78		96.56		***
%ELL	14.61		12.05		19.62		***
%Special education	12.66		11.25		13.89		***
%Physically disabled	3.28		3.47		3.49		
<i>Panel III: Working Conditions</i>							
Experienced teachers	75.27	(0.21)	76.32	(0.19)	72.46	(0.23)	
Leadership	-0.02	(0.24)	0.15	(0.88)	-0.22	(0.88)	***
Professional development	-0.01	(0.20)	0.25	(0.89)	-0.22	(1.02)	***
Collegial support	-0.01	(0.19)	0.27	(0.90)	-0.24	(0.89)	***
Instructional coherence	0.02	(0.97)	0.03	(1.03)	-0.04	(1.00)	
Analyze data	0.02	(0.98)	0.13	(0.99)	-0.09	(0.94)	
Plan & set goals	0.02	(0.99)	0.30	(0.87)	-0.21	(0.94)	***
Capacity building	0.02	(0.98)	0.14	(0.85)	-0.02	(0.99)	
Monitor & revise	0.14	(0.99)	0.08	(0.92)	-0.02	(0.99)	
Number of schools	670		143		131		

*Note.* Top and bottom quintiles of schools by the proportion of students eligible for Free or Reduced Price Meals (FARMS). The top quintile is 81.59 percent or greater eligible for FARMS; the bottom quintile is 44.55 percent or fewer eligible for FARMS. Comparison of means based on Tamhane’s T2, which does not assume equal variances across groups.

\* $p < 0.05$ . \*\*  $p < 0.01$ . \*\*\* $p < 0.001$ .

The findings with regard to teacher perception data generally suggest that schools serving wealthier students have better working conditions. In the wealthiest (low FARMS) schools, teachers express more positive perceptions of leadership, professional development and collegial support; in addition, external ratings of the school’s work in planning and setting goals are higher. Though schools serving more low-income students have lower average ratings on other Quality Review constructs (instructional coherence, analyzing data, capacity building, and

monitoring and revising), the differences between wealthy and poor schools in the means of the Quality Review constructs are not statistically significant.

The school working conditions are positively correlated, as seen in Table 3.2. Not surprisingly, some of the highest correlations are among working conditions derived from the same instrument. For example, leadership and professional development, both derived from the school survey, have a strong positive correlation ( $r=0.779$ ) as do leadership and collegial support ( $r=0.639$ ). The five factor scores from the Quality Review are all positively and significantly correlated, with correlations ranging from 0.694 to 0.822. Lower correlations between the Quality Review factors and the factors based on teachers' perceptions may be due to the fact that the constructs are made up of different types of items from different instruments, and from individuals with different perspectives (external raters vs. teachers). In addition, I averaged teacher perceptions from school climate surveys across three years, but I rely on just one year of Quality Review scores. If school survey results changed dramatically over the three years, correlations between the three-year averages and the Quality Review scores may be attenuated by variation in the school survey.

Though smaller than correlations between factors from the same instruments, the correlations between three of the school survey factors (leadership, professional development, and collegial support) and all five of the Quality Review factors are statistically significant and positive ( $r=0.155$  to  $0.240$ ). Consistent with the underlying constructs, the highest of these correlations is between teachers' perceptions of the quality of professional development and external observers' ratings of the extent to which the school aligns its leadership development and structured professional collaboration around meeting the school's goals. This positive

correlation suggests that teachers' perceptions of their working conditions are at least somewhat consistent with the perceptions of external reviewers.

Table 3.2 Correlations between Working Conditions

	Leadership	Professional development	Collegial support	Learning community	Instructional coherence	Analyze data	Planning/ goal-setting	Capacity building
Leadership	1.000							
Professional development	0.779***	1.000						
Collegial support	0.639***	0.632***	1.000					
Learning community	0.072~	0.002	0.401***	1.000				
Instructional coherence	0.163***	0.161***	-0.018	-0.052	1.000			
Analyze data	0.170***	0.155***	-0.003	-0.022	0.735***	1.000		
Planning/goal-setting	0.245***	0.238***	0.028	-0.004	0.696***	0.760***	1.000	
Capacity building	0.222***	0.240***	0.014	-0.028	0.694***	0.729***	0.767***	1.000
Monitor/revise	0.209***	0.204***	0.016	-0.043	0.729***	0.822***	0.760***	0.718***

\* $p \leq 0.05$ . \*\*  $p \leq 0.01$ . \*\*\* $p \leq 0.001$ .

How much of the variation in teacher effectiveness is across schools?

Teacher effectiveness varies across schools, as expected. Table 3.3 displays the intraclass correlation coefficients, which measure the proportion of variance in each outcome that is between schools, as well as the reliability of the outcomes ( $\lambda$ ). The proportion of the variance in teacher effectiveness that is between rather than within schools is significant, if small. When using averages of up to three years of data, six percent of variation in average teacher value-added estimates in English language arts is across schools, and about 12 percent of variation in average teacher value-added estimates in mathematics is across schools.<sup>24</sup>

Table 3.3 Interclass Correlation Coefficients and Reliability, by Subject

Outcome	$\sigma^2$	$\tau$	$\tau / (\tau + \sigma^2)$	$\lambda$
ELA value-added estimate	0.928	0.057	5.9%	0.355
Math value-added estimate	0.837	0.113	11.9%	0.527

Since the amount of variation across schools was significant, school contextual factors—such as student demographics—and teachers’ working conditions may explain why teachers are more effective in some schools and less so in others.

Prior to examining school working conditions, I added an indicator of whether the teacher has three or more years of experience to the level-1 model. On average, teachers with three or more years of experience are 0.165 standard deviations more effective in English language arts and 0.123 standard deviations more effective in mathematics compared to teachers with less experience. I retain teacher experience in the model to control for differences across schools in the proportion of experienced teachers.

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<sup>24</sup> When looking at just one year of data, the proportion of variance between schools is higher. For example, with just 2008 data, 17 percent of the variation in English language arts value-added is between schools and 20 percent of the variation in mathematics value-added is between schools. Such results are more consistent with the proportion of between-school variation found in Atteberry, Loeb, and Wyckoff (2012).

School context and teacher effectiveness

School contextual variables appeared to be unrelated to average teacher effectiveness in English language arts, as seen in Table 3.4. The teacher effectiveness scores included controls for these demographic variables at both the student and classroom levels, which may explain why we do not see the typical negative relationship between high proportions of disadvantaged students and the outcome. However, two school contextual factors are significant predictors of average effectiveness in mathematics. Specifically, teachers are about six percent of a standard deviation less effective in mathematics in schools with higher proportions of students receiving free or reduced price meals (FARMS) and about 17 percent of a standard deviation less effective in mathematics in schools with 90 percent or greater minority students.

Table 3.4 Between-Schools Models: School Context and Teacher Effectiveness

	ELA		Mathematics	
	Coefficient	(SE)	Coefficient	(SE)
Intercept	0.011	(0.036)	0.132	(0.040)
FARMS	0.018	(0.020)	-0.057	(0.022) **
Days absent	0.007	(0.010)	-0.010	(0.010)
Minority	-0.064	(0.039)	-0.169	(0.043) ***
ELL	0.043	(0.032)	-0.024	(0.035)
Special education	0.013	(0.033)	-0.023	(0.036)
Physically disabled	0.003	(0.032)	-0.036	(0.035)
<i>Variance component</i>	0.056	***	0.096	***
<i>Reliability</i>	0.338		0.484	

\* $p < 0.05$ . \*\*  $p < 0.01$ . \*\*\* $p < 0.001$ .

Working conditions and teacher effectiveness

Table 3.5 reports the results for the model in which I add working conditions to the between-school models to address the third research question, but continue to control for school contextual factors. Results regarding teacher effectiveness in English language arts model are in the second column and results regarding teacher effectiveness in mathematics are in the third

column. The last two rows provide estimates for the variance between schools and the reliability of the outcome for the model. I discuss results for collegial qualifications first, followed by teacher perceptions of working conditions and external reviewers' ratings of working conditions.

While the level-1 models reveal that a teacher's own experience is a positive predictor of his or her effectiveness, teachers in schools with a greater proportion of experienced teachers did not have more effective teachers on average in either subject, compared to schools with a moderate proportion of experienced teachers.<sup>25</sup> This finding is unexpected; because experienced teachers are generally more effective than their novice peers, I anticipated that having a more experienced staff would provide spillover benefits that would increase average teacher effectiveness. However, in at least one other study researchers found that novice mathematics teachers outperform more experienced mathematics teachers (Harris & Sass, 2011). Thus, experience may be a poor proxy for the effectiveness of colleagues and therefore limited in its ability to predict average teacher effectiveness.

I find mixed results regarding the relationship between teachers' perceptions of working conditions and effectiveness. Teachers' perceptions of the quality of leadership and professional development did not have a statistically significant relationship with effectiveness in either subject, controlling for other variables in the model. However, I find that teacher's perceptions of collegial support are significantly and positively related to effectiveness in both subjects. On average, teachers in schools with higher perceived support from colleagues (one standard deviation above average) are 0.047 standard deviations more effective in English language arts,

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<sup>25</sup> Since the aggregate of teacher experience was not normally distributed, I created two categories representing high and low average experience. Schools in which 85 percent or more of the teachers have three or more years of experience are considered schools with high average experience; schools in which 70 percent or fewer have three or more years of experience are categorized as low average experience.

and 0.064 standard deviations more effective in mathematics, compared to teachers in schools with average perceptions of support from colleagues.

Table 3.5 Between-Schools Models: Working Conditions and Teacher Effectiveness

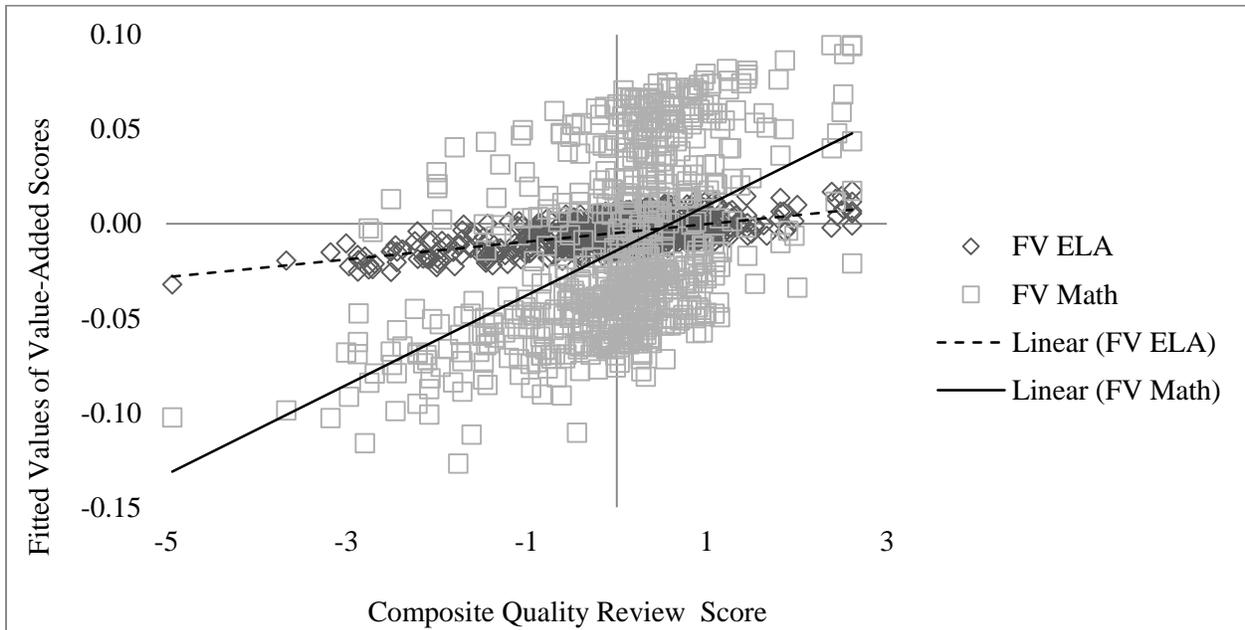
	ELA		Mathematics	
	Coefficient	(SE)	Coefficient	(SE)
Intercept	0.006	(0.043)	0.012	(0.046)
High experience	-0.016	(0.039)	-0.043	(0.042)
Low experience	0.014	(0.040)	0.050	(0.043)
Leadership	-0.007	(0.031)	0.000	(0.033)
Professional development	0.000	(0.027)	-0.000	(0.029)
Collegial support	0.047	(0.023) *	0.064	(0.025) *
Quality Review	0.033	(0.019) ~	0.075	(0.020) ***
<i>Variance component</i>	0.052	***	0.085	***
<i>Reliability</i>	0.325		0.455	

Note. Includes school context controls at level 2 and controls for teacher experience at level 1.

~  $p < 0.10$ . \*  $p < 0.05$ . \*\*  $p < 0.01$ . \*\*\*  $p < 0.001$ .

These relationships between teacher perceptions of school working conditions and their effectiveness might be viewed as susceptible to attribution bias: teachers who are ineffective may blame the school environment for their failures, and thus be more likely to rate their working conditions unfavorably. However, this type of bias would not exist for constructs based on the Quality Review, since those ratings are provided by external observers. In the last row of Table 3.5, I present results using a composite measure of working conditions as rated by external reviewers. I use a composite rather than the separate factor scores as the separate measures are correlated. Replacing teachers' perceptions of working conditions with this exogenous measure produces substantively similar results in the sense that measured aspects of the school's environment are related to teacher effectiveness. This analysis suggests that the relationship between working conditions and teacher effectiveness is not simply a product of attribution bias. Figure 3.4 shows a positive trend for effectiveness in both English language arts and

mathematics as Quality Review scores increase, though this trend is considerably stronger for mathematics.



*Figure 3.4* Fitted values for mathematics and English language arts value-added scores as a function of composite quality review score

To better understand the results regarding the Quality Review composite, I conducted a series of regression models that regress teacher effectiveness on each Quality Review construct separately. Table 3.6 provides the output from the model for English language arts model in the second column and mathematics in the third column. Four of the five Quality Review constructs are significantly and positively related to teacher effectiveness in English language arts. The four constructs include the extent to which school leaders and staff consistently 1) gather, analyze and share information on student learning outcomes to track progress, 2) engage the school community and use data to plan and set learning goals, 3) build capacity via observation of classroom teaching, analysis of learning outcomes, and professional collaboration to improve student learning, and 4) evaluate the quality of decisions and assessment systems and the

effectiveness of professional development, and make adjustments as needed. One additional Quality Review construct, the extent to which the school aligns curriculum, instruction and organizational decisions, predicts teacher effectiveness in mathematics, but not in English language arts.

Table 3.6 Results from Separate Regressions for Each Quality Review Construct

	ELA		Mathematics	
	Coefficient	(SE)	Coefficient	(SE)
Instructional coherence	0.011	(0.016)	0.067	(0.017) ***
Analyze data	0.030	(0.016) ~	0.053	(0.018) **
Plan & set goals	0.043	(0.016) **	0.086	(0.017) ***
Capacity building	0.055	(0.016) ***	0.095	(0.017) ***
Monitor & revise	0.026	(0.016) ~	0.053	(0.017) **

*Note.* Includes school context controls at level 2 and controls for teacher experience at level 1.  
 ~  $p < 0.10$ . \*  $p < 0.05$ . \*\*  $p < 0.01$ . \*\*\*  $p < 0.001$ .

Of the Quality Review constructs, capacity building stood out as a particularly strong predictor of both English language arts and mathematics. Schools that support teachers’ development through frequent cycles of classroom observation, provision of feedback, and structured professional collaboration appeared to be generating returns on this investment in human capital, though it should be noted that the coefficients are quite small.

After controlling for school context, teachers’ working conditions explain about 7 percent of the remaining variation between schools in teachers’ effectiveness in English language arts and 11 percent of the remaining variation between schools with regard to teachers’ effectiveness in mathematics. In addition, accounting for teachers’ working conditions reduces the observed relationships between school aggregate demographic characteristics and teacher effectiveness. For example, compared to the model with just contextual factors, when working conditions are included in the model predicting average teacher effectiveness in mathematics the negative

coefficients on high minority schools and the proportion of students eligible for free or reduced meals are reduced slightly.

*Working conditions and teacher effectiveness: moderating factors*

For certain working conditions, the relationship between working conditions and teacher effectiveness appeared to be moderated by school poverty (as indicated by the proportion of students eligible for free or reduced price meals). While the construct capturing schools' instructional and organizational coherence is not a significant predictor of teacher effectiveness in English language arts generally, the significant interaction with school poverty indicates that instructional coherence is related to effectiveness differentially depending on school context.<sup>26</sup> Specifically, instructional coherence exhibits a positive relationship with teacher effectiveness in English language arts than in schools serving less advantaged students, but a negative relationship in schools serving more advantaged students, as seen on the left side of Figure 3.5. The positive relationship between instructional coherence and effectiveness in high poverty schools is stronger than the negative relationship between instructional coherence and effectiveness in low poverty schools; post-hoc analyses indicate that the negative relationship is not statistically significant.

The extent to which the school has structures for monitoring and evaluating progress throughout the year and for flexibly adapting plans and practices to meet goals has a borderline significant positive main effect on teacher effectiveness in English language arts, but that

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<sup>26</sup> In this model, I include the full set of school context variables as well as instructional coherence and the interaction between FARMS and instructional coherence at level 2; I also control for collegial support at level 2, as it had a statistically significant relationship with the outcome.

relationship is also contingent on school context.<sup>27</sup> Among schools serving less advantaged populations, those schools that are more highly rated on monitoring progress and revising plans have higher average teacher effectiveness in English language arts. In schools serving more advantaged students, monitoring progress and revising plans has a slight negative relationship with teacher effectiveness, but again this negative relationship is much weaker than is the positive relationship in schools serving less advantaged students and is not statistically significant. The right hand side of Figure 3.5 displays the relationship between monitoring and teacher effectiveness in high and low poverty schools.

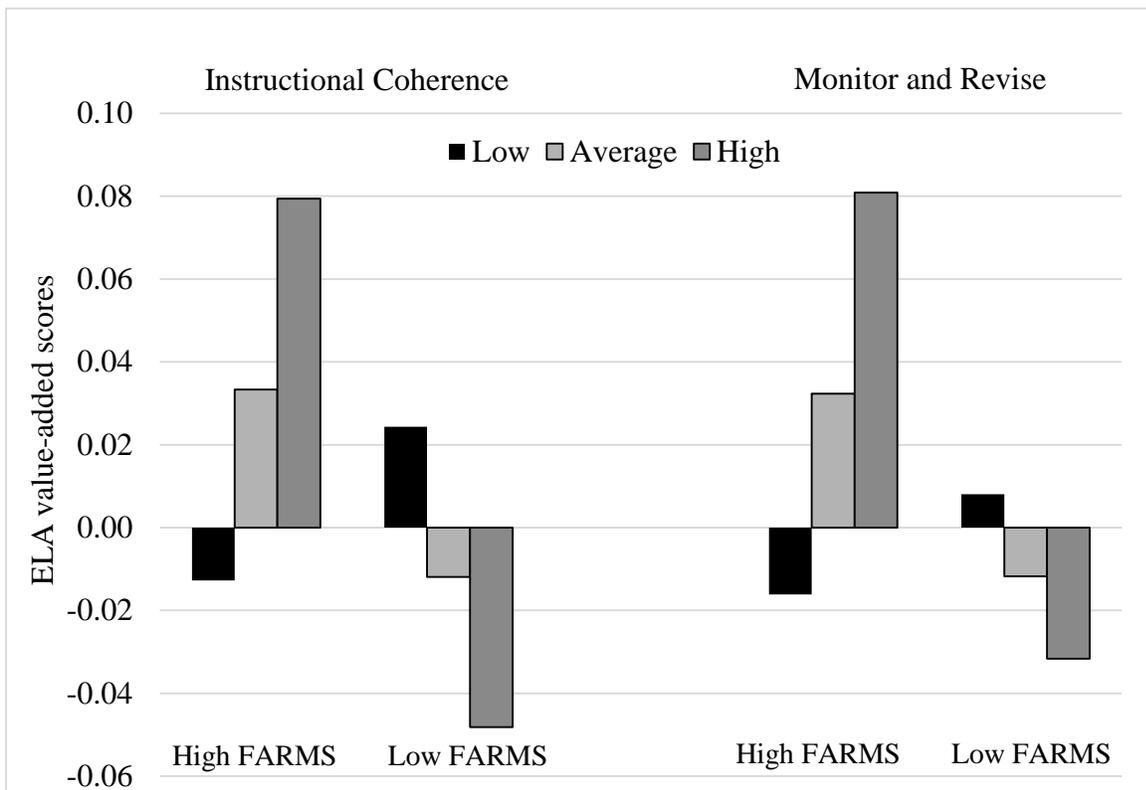


Figure 3.5. Teacher effectiveness in English language arts: interactions between school context and working conditions.

<sup>27</sup> In this model, I include the full set of school contextual variables, monitoring and revising, and the interaction between FARMS and monitoring and revising at level 2; I also control for collegial support at level 2, as it had a statistically significant relationship with the outcome.

With regard to teachers' effectiveness in mathematics, instructional coherence has a significant positive main effect, but the strength of that relationship is contingent on school poverty.<sup>28</sup> In schools with high proportions of students receiving free or reduced meals, instructional coherence has a much stronger relationship with teacher effectiveness in mathematics than was the case in schools serving more advantaged students. Average teacher effectiveness in mathematics is 17 percent of a standard deviation higher in high poverty schools with high instructional coherence than in high poverty schools that lack instructional coherence. In low poverty schools, the difference between schools with high as opposed to low ratings on instructional coherence is just six percent of a standard deviation. See Figure 3.6.

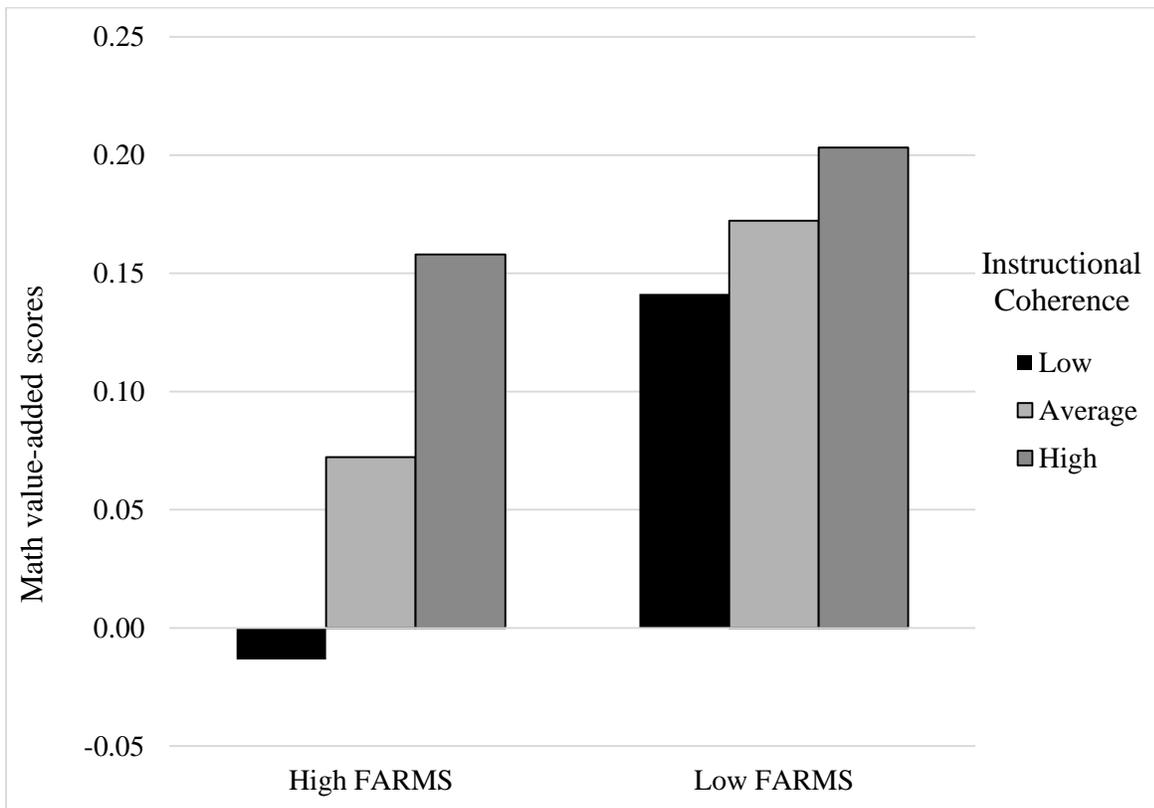


Figure 3.6. Teacher effectiveness in mathematics interactions between school context and working conditions.

<sup>28</sup> The model includes the full set of school context variables, instructional coherences, and the interaction between FARMS and instructional coherence at level 2; I also control for collegial support at level 2, as it had a statistically significant relationship with the outcome.

## *Discussion*

This study addresses whether working conditions, such as administrators' support of teachers and the extent to which teachers collaborate, are related to teachers' effectiveness as measured by average test score gains. To some extent, I find that teachers' working conditions are directly associated with teacher effectiveness. These results are consistent with Johnson, Kraft and Papay (2012) and Ladd (2009), and provide support for the notion that teachers' working conditions are, indeed, students' learning conditions (Hirsch & Emerick, 2007). The results are also consistent with a framework that postulates that a school's capacity is contingent upon the availability of resources, including social capital and informational resources (Rice & Croninger, 2005). Schools with greater social capital in the form of collegial support among teachers have more effective teachers. In addition, teacher effectiveness is related to informational resources within schools, such as the extent to which the school uses data and engages in strategic decision-making.

While this study provides a description of working conditions that are related to teacher effectiveness, it is not intended to suggest causality. Students and teachers are not randomly assigned to schools and classrooms; no statistical model can fully address this lack of randomization, and so estimates of teachers' effects based on these models cannot be interpreted as causal (Rothstein, 2010). The relationship between working conditions and teacher effectiveness may exist for several reasons. Schools with strong collegial support may be able to attract a larger pool of teaching candidates; a larger pool gives those with hiring power more choices of teacher candidates. It may be that effective teachers are particularly drawn to schools with collaborative environments, or that schools with such conditions are more likely to retain

their effective teachers. Alternatively, high levels of collegial support may foster improved teaching practice as colleagues learn from one another.

Since this study is a cross-sectional exploration of data, reverse causality may explain some of the relationships observed here. For example, it is not clear whether collegial support makes teachers more effective, or whether more effective teachers are more inclined to be supportive. In addition, use of state assessment data in developing a proxy for teacher effectiveness limits generalizability to teachers of students in tested grades. Another important limitation is that the measure of teacher effectiveness used (based on students' standardized test scores) is an attempt to capture success in teaching, but it represents only a portion of the curriculum and just one of many goals of schools. Furthermore, successful teaching is just one aspect of quality teaching (Fenstermacher & Richardson, 2005). A teacher's value-added score is not necessarily indicative of good teaching practice and an outcome based on test scores alone cannot capture the full complexity of high quality teaching or the full aim of education.

Nevertheless, this study makes a contribution to the literature. Whereas previous work focused on outcomes less directly linked to educational productivity, such as teacher turnover, or on school-level academic growth, I use estimates of teacher effectiveness in generating student achievement gains. While this measure only provides information on one of the many aspects of teacher quality that stakeholders find valuable, teacher effectiveness is an appropriate outcome given a theory of action that teachers' working conditions have a direct impact on their productivity. In addition, the rich New York City datasets allow for the triangulation of information sources. General consistency (in results based on external review ratings and teacher perceptions) indicates the convergent validity of these findings and provides further

support for the idea that working conditions, whether measured by perceptions of those experiencing the working conditions or by the perceptions of external observers, are related to teachers' productivity.

These findings build on and extend the work of previous researchers who have explored the relationship between working conditions and teacher learning opportunities (Rosenholtz, 1989), satisfaction (Johnson, Kraft & Papay, 2012), intention to transfer (Ladd, 2009), and school achievement growth (Bryk and Schneider, 2002; Johnson, Kraft & Papay, 2012; Ladd, 2009). As many have noted (Bryk & Schneider, 2002; Rosenholtz, 1989), social relationships are a core aspect of the teaching profession. Collegial support allows for collective problem-solving, opportunities to exchange ideas and feedback, and support from peers facing similar challenges. Whereas prior work indicates that professional interactions occur with greater frequency in high-achieving schools (Little, 1982) and that school average student achievement growth is higher in schools with better collegial relationships (Johnson, Kraft & Papay, 2012), this study looks specifically at how these social relationships relate to teachers' average effectiveness. Consistent with what prior work suggests, teachers' effectiveness is higher in schools where teachers perceive supportive collegial relationships.

On the other hand, controlling for other working conditions, I did not find that perceived quality of leadership or professional development was associated with teacher effectiveness. The finding that teachers' effectiveness appears to be unrelated to perceived quality of professional development is perhaps unsurprising, given the disappointing results of the review of literature on professional development (Garet et al., 2008, 2010). In fact, Ladd (2009) found a *negative* relationship between teachers' perceptions of the adequacy of professional development and student achievement; she noted that policymakers might compensate schools with low

performance by offering additional professional development opportunities. Yet numerous studies have pointed to the importance of school leadership in terms of teacher retention (Boyd et al., 2011; Grissom, 2011; Ladd, 2009) and school average achievement (Johnson, Kraft, & Papay, 2012; Ladd, 2009). While I find a small positive relationship between leadership and teacher effectiveness in English language arts when it is the only working condition in the model, this effect disappears when controlling for other working conditions.

However, I did find that the Quality Review composite predicted teacher effectiveness in both subjects; this composite is arguably a reflection of leadership quality. In addition to supplemental data, the reviewers draw upon a self-evaluation completed by school leadership. Many of the indicators in the Quality Review rubric focus on leadership practice. For example, the rubric descriptors include language such as, “School leaders regularly engage families” and “School leaders gather and analyze a range of data.” Thus, it would appear that the manner in which leadership is measured is an important consideration with regard to studies of school working conditions. While I do not find a consistent positive relationship between teachers’ perceptions of school leadership and teacher effectiveness, I do find a positive relationship between external reviewers’ ratings of school leadership practices and teacher effectiveness.

The Quality Review findings may also be interpreted as evidence that informational resources may play a role in either attracting and retaining effective teachers, or helping teachers become more effective. Generating information through data analysis has been promoted as having the potential to improve instructional decision-making despite limited evidence of the effectiveness of this approach (Hamilton et al., 2009). I find that in schools with well-developed structures and processes to support data-informed decision-making, teacher average effectiveness

is higher than average. This finding is consistent with a framework that posits that informational resources can enhance teacher effectiveness.

Among the Quality Review constructs, the extent to which schools used data to build capacity was one of the stronger predictors of teacher effectiveness in both subjects. In rating schools on this construct, observers attempted to capture the extent to which school staff use observation of classroom teaching and analysis of learning outcomes to elevate school-wide instructional practices, engage in structured professional collaboration, and provide professional development that promotes reflection and opportunities for leadership growth. In other words, the items that make up the construct of schools' use of data to build capacity include aspects of school leadership and professional collaboration as well as data-informed decision-making. Therefore, the positive relationship between use of data to build capacity and teacher effectiveness suggests that specific school leadership and teacher collaboration practices contribute to teachers' productivity.

In addition, I find that certain aspects of school working conditions, including instructional coherence, may matter most in schools serving disadvantaged students. Instructional coherence encompasses curricula, pedagogy, the extent to which school-wide organizational decisions support the school's instructional goals, and whether the school exhibits a culture of trust and positive attitudes toward learning. Teacher effectiveness is more strongly related to instructional coherence in high poverty schools than in more advantaged schools. This finding is consistent with other work that suggests that the quality of working conditions may be especially impactful in disadvantaged schools, in that working conditions have a stronger impact on teacher outcomes in disadvantaged schools (Grissom, 2011).

This study points to several potential avenues of future research. Given that these findings are based on non-experimental data, further research would be required to determine whether policies that promote collegial support or the use of data to improve teacher practice can enhance teacher effectiveness. Furthermore, the interactions between working conditions and school context suggest that we should continue to investigate how school context interacts with practices and policies, and what conditions are required to support school improvement efforts.

## Chapter 4: Do Working Conditions Influence Changes in Novice Teachers' Effectiveness?

### Introduction

While results regarding most teacher characteristics are mixed, considerable evidence indicates that novice elementary school teachers are less effective than teachers with at least a few years' experience (e.g. Clotfelter, Ladd, & Vigdor, 2006; Harris & Sass, 2011; Rockoff, 2004). Federal and state legislators have developed numerous policies in an effort to provide support for novice teachers during the early years of their career. For example, the No Child Left Behind Act permits Title II funds to be used for mentoring programs and intensive professional development for teachers new to their profession (20 USC 6613). In addition, many researchers have documented the ways new teachers learn informally from their colleagues and have pointed to these network of relationships as an important form of support for novice teachers. However, formal and informal support for novice teachers may vary dramatically across schools, as indicated by prior studies (Kardos, Johnson, Peske, Kauffman, & Liu, 2001; Rosenholtz, 1989). In this study, I explore the aspects of working conditions that might support new teachers' growth in effectiveness. I begin by reviewing the relevant research on the relationship between teacher experience and effectiveness, and working conditions that may be related to novice teachers' growth in performance.

### Review of Literature

I review two broad areas of relevant literature—the relationship between teacher experience and effectiveness and the relationship between teacher working conditions and effectiveness, and focus when possible on the effectiveness and experiences of novice teachers.

Because relatively little work explores how working conditions influence novice teachers' performance over time, I include research that pertains to teacher retention and teacher practices. In doing so, I assume that factors that influence teacher retention and practices may also influence changes in performance of novice teachers during the early years of their careers.

*Teacher Experience and Effectiveness.* Though traditional salary schedules tend to linearly reward teachers for years of experience, the research on teacher experience yields a mixed message regarding relevance of additional years of experience as a predictor of effectiveness. Many studies indicate that the increase in teacher effectiveness associated with additional years of experience diminishes after the first few years of teaching. Using a national dataset, Croninger, Rice, Rathbun and Nishio (2007) found that first grade students of novice teachers have significantly lower reading achievement compared to students whose teachers had more than two years of experience, but they found no further gains associated with additional years of experience. They also found no differences in mathematics achievement as a function of teacher experience (including between novice teachers and teachers with more years of experience). Parlardy and Rumberger (2008) used the same dataset as Croninger, Rice, Rathbun and Nishio (2007), but found no significant relationship between teacher experience and either reading or mathematics achievement gains. This conflicting evidence may reflect, in part, differences in the measurement of teacher experience.<sup>29</sup>

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<sup>29</sup> Parlardy and Rumberger (2008) compares teacher years of experience in their current *school*, while Croninger et al. (2007) uses two dichotomous variables that indicate the number of years teachers have taught in their current *grade*. In addition, the Parlardy study compared teachers with five or more years of experience to those with fewer than five years of experience, while the Croninger et al. study compared teachers with zero to two years, three to four years, and five or more years of experience.

I found some evidence that more refined categories (e.g., the three categories used by Croninger et al. as opposed to one dichotomous indicator used by Parlady and Rumberger) of experience may be better suited to capturing the effects of experience. Using seven categories of teacher experience and data from 1995–2004 on North Carolina students in third, fourth, and fifth grade, Clotfelter, Ladd, and Vigdor (2007) found that students of teachers with more experience had higher reading *and* mathematics achievement. But the authors also noted that assessments in North Carolina were closely aligned with what students are expected to know and be able to do, so “test scores are likely to measure more fully what teachers have taught than in many other states” (Clotfelter, Ladd, and Vigdor, 2006, p. 782). In other words, besides differences in the measurement of teacher experience, divergent study results may be due to differences across states in the extent to which standardized assessments capture the pedagogical experiences of teachers.

The aforementioned studies build on previous work that examines the relationship between teacher experiences and student achievement. Although study results are mixed, considerable evidence indicates that the relationship between experience and achievement is non-linear—specifically, that returns to additional experience may be greatest in the first few years of teaching. Rivkin, Hanushek, and Kain (2005) used administrative data on students in grades four through seven in Texas to explore this non-linearity. They found that “beginning teachers and to a lesser extent second and third year teachers in mathematics perform significantly worse than more experienced teachers” (p. 447), but do not find returns to experience beyond the first few years. Efforts to address this non-linearity create a potential explanation for conflicting findings: variations in the number of years of experience used as the cutoff in dichotomous indicators of experience. Both Clotfelter, Ladd and Vigdor (2006) and

Rivkin, Hanushek, and Kain (2005) noted that about half the gain in student test scores occurs for the first one or two years of teaching after which the relationship between experience and student test scores flattens considerably.<sup>30</sup> These findings suggest that researchers who examine teacher experience should distinguish between very new teachers (say, fewer than two years) and early career teachers (e.g. those with three to five years of experience), because the returns to experience are likely greatest in the first two years.

While the studies described above rely on variation in teacher experience levels across teachers to estimate returns to experience, several recent studies have used teacher fixed effects to strengthen causal inferences by isolating the within-teacher returns to experience. By measuring the relationship between teachers' experience and student achievement and by using variation across years for individual teachers, researchers avoid confounding the causal effect of teaching experience with differences in teacher quality across cohorts and nonrandom sorting of teachers to students. Rockoff's (2004) examination of approximately 10,000 elementary school students (grades one through six) in New Jersey concluded that greater teacher experience has a statistically significant positive effect on achievement in reading, but he found less support for a relationship between teacher experience and mathematics achievement. Using longitudinal data on students in grades two through five in Los Angeles, Buddin and Zammato (2009) found that student achievement in reading and mathematics increases with teacher experience, though they describe the relationship as weak and largely reflective of poor outcomes for teachers during their first year or two in the classroom.

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<sup>30</sup> Interestingly, Rockoff (2004) found that the relationship between experience and student achievement may be linear for some content areas (such as reading comprehension) and nonlinear for others (vocabulary), further substantiating the need for researchers to conduct sensitivity analyses regarding how teacher experience is measured and the assessments used to capture the influence of prior experience in a classroom.

Papay and Kraft (2011) used teacher fixed effects to isolate the within-teacher returns to experience with data from school years 2000-2001 through 2008-2009 in a large, urban school district in the southern United States. They found that teachers do continue to improve (as measured by students' reading and mathematics scores) later in their careers, albeit not as much as in their early years. Harris and Sass (2011) also employed teacher fixed effects and found similar results among teachers of Florida students in grades three through ten. Specifically, elementary and middle school teacher productivity (again, as measured by students' reading and mathematics scores) increased with experience. The largest gains from experience occur in the first few years, but gains continued beyond the first five years of a teacher's career. Among high school teachers, Harris and Sass found experienced teachers were generally less productive than when they were novices.

In a study based on data from a randomized assignment, Nye, Konstantopoulos, and Hedges (2004) explored the size of teacher effects and the relationship between teacher experience and student achievement gains. Drawing on data from 79 elementary schools in 42 school districts in Tennessee, the authors examined gains in reading and mathematics achievement among students in first through third grades and found teacher experience has a statistically significant effect on second grade reading and third grade mathematics achievement. Similar to the use of fixed effects, the randomized assignment of teachers in this study reduces some of the bias caused by the tendency for more experienced teachers to work with students with more favorable characteristics. Thus, this study provides additional evidence regarding the relationship between teacher experience and effectiveness.

*The Role of Teachers' Working Conditions.* While some evidence indicates that new teachers, compared to their counterparts, improve over at least the initial years of teaching, recent studies have revealed variation across schools in the relationship between teacher experience and effectiveness. For example, using statewide administrative datasets from North Carolina and Florida, Sass, Hannaway, Xu, Figlio, and Feng (2012) found that gains in elementary school teachers' performance from additional years of teaching experience are much stronger in lower-poverty schools than in higher-poverty schools. The authors investigated several potential explanations, and noted that these lower returns to experience do not appear to be related to differential attrition. Loeb, Kalogrides, and Béteille (2011) revealed that among teachers in Miami-Dade County Public Schools, those who are hired to work in more effective schools improved more rapidly from year to year.

One plausible hypothesis to explain these findings is that the quality of social capital and informational resources in a teacher's work environment may influence the extent to which they improve over time. In the following section, I review the literature of various aspects of the school environment that might influence novice teachers. I focus on leadership, professional development opportunities, collegial support, and strategic data use. Because relatively little work explores how working conditions influence improvement in novice teacher performance, I examine related literature about working conditions that influence novice teachers' decisions and actions.

*Leadership.* Several studies have indicated that teachers' perceptions of school leaders play a role in the retention of novice teachers. Boyd et al. (2011) explored the relationship between school factors and teacher retention decisions in New York City and found that

teachers' perceptions of the school administration had the greatest influence on teacher retention decisions, and that this "administration effect" was consistent across the full sample of teachers, including first-year teachers. Using a survey of teachers who had recently left teaching, the authors confirmed these results. In another study, Pogodzinski, Youngs, Frank and Belman (2012) analyzed survey data from 184 first- through third-year teachers in 99 schools to assess whether school leadership had an impact on teachers' desire to remain in teaching. The authors used multilevel logistic regression to control for a prior measure of intent to remain teaching, and found that the probability that a novice teacher reports a desire to remain teaching within her school decreased by approximately two percentage points when she perceived the quality of relations between teachers and administrators with her school as poor.

Qualitative work on 50 first- and second-year Massachusetts teachers supports the notion that novice teachers' career decisions are influenced by the quality of support from school leaders (Johnson et al., 2004). Moreover, new teachers' accounts of their experiences indicate that school leadership plays a key role in supporting their learning. New teachers looked to school leaders for helpful advice, guidance, constructive feedback, and problem-solving. Those who left teaching reported disappointment with a lack of support, which they viewed as necessary if they were to become successful with their students. Teachers who moved to different schools looked for administrators who "created structures of support" and "understand the challenge of being a new teacher" (p. 115). These findings suggest that the working conditions that are related to teacher turnover are also related to teachers' sense of efficacy.

In a study of six principals and the new teachers working with these principals, Youngs (2007) found that three of the principals promoted new teachers' instructional growth through

direct interactions, evaluations and feedback, and by encouraging a professional culture in which veteran teachers supported their novice colleagues. In contrast, the other three school leaders did not provide the same supports for new teachers. One focused predominantly on provision of assistance with classroom management to the exclusion of instructional support; two provided minimal feedback after classroom observations and paired new teachers with mentors in different grades or subjects, which may have limited the mentors' ability to provide grade- and subject-specific support. Although this study does not look at administrative support aimed specifically at novice teachers, it does document that new teachers experience varying degrees of what is typically thought of as positive forms of support.

*Professional Development: Mentoring and Induction.* While numerous policies have been developed to encourage formal professional development for new teachers through mentoring and induction, studies suggest that such programs have had mixed success. Lopez, Lash, Schaffner, Shields, and Wagner (2004) reviewed the literature and concluded that although the research includes some positive findings, “the studies are not strong enough for us to conclude that induction works—that it improves teacher retention or effectiveness (measured in terms of student achievement or otherwise)” (p. 32). While these studies' designs do not lead to conclusive findings, they do provide sufficient evidence to warrant examinations of how professional relationships may influence the performance of novice teachers.

Using data from the nationally representative Schools and Staffing Survey, Smith and Ingersoll (2004) found that new teachers who were provided mentors working in the same subject area and who participated in induction activities were less likely to move to other schools and less likely to leave teaching after their first year. While these findings are positive, the study

design is quasi-experimental rather than experimental; thus, it is not clear whether mentoring and induction activities bolstered retention or whether teachers who were likely to stay in their schools anyway were also more likely to participate in such activities. Nonetheless, the study does provide evidence of a correlational relationship between specific efforts to provide novice teachers with relational resources and their decisions to continue teaching.

More recently, based on a randomized experiment in 17 urban districts, Glazerman, Isenberg, et al. (2010) found that among teachers who received two years of comprehensive induction, the induction had a positive and statistically significant impact on student achievement in the third year. The authors noted that compared to their control group counterparts, treatment teachers were significantly more likely to report receiving suggestions on improving instructional practices from their mentors. Although small sample sizes and subsequent lack of statistical power prevent conclusive findings, the authors find support for the notion that increases in student achievement occurred via an improved classroom culture among treatment teachers, which in turn influence student learning. However, they also noted that in the first two years of the study, assigning teachers to comprehensive induction support did not translate into positive impacts on key outcomes, including classroom practices and student achievement.

One possible consideration regarding the results of studies that examine the influence of targeted interventions is the extent to which the broader collegial support for novice teachers influences novice teacher performance and the effects of specific programs designed to support novice teachers. This broader form of collegial support is discussed further in the next section.

*Collegial Support and Learning Communities.* Collegial support and learning communities play a critical role in fostering retention of those new to the teaching profession.

Norms of collaboration have been described in a variety of ways in the literature. McLaughlin and Talbert (2001) used the term “learning community” as shorthand for environments where collaboration norms entail “teachers’ joint efforts to generate new knowledge of practice and their mutual support of each others’ professional growth” (p. 75). Teachers in schools with such communities describe their colleagues as “continually share[ing] solutions and insights” (p. 76). Johnson and Kardos (2004) referred to “integrated professional cultures” when describing schools that operate under the assumption that schools best serve students when teachers assist one another and share responsibility for students’ learning as well as their own learning.

Based on qualitative data that tracked novice teachers in Massachusetts from 1999 to 2003, Johnson and Kardos (2004) uncovered strong, positive relationships between novice teachers’ ongoing professional interaction with experienced colleagues and teacher retention. They found higher retention among novices in schools with integrated professional cultures, and noted that such cultures “cultivate a close sense of collective responsibility and community among teachers” (p. 163). Drawing on the same data, Johnson (2004) noted that new teachers praised schools that provided time for teachers to plan and work together, and that those who transferred left schools “where teachers worked in isolation and...sought schools offering organized support for new teachers and schoolwide, collegial interaction” (p. 114). Smith and Ingersoll’s (2004) exploration of the nationally representative SASS data also indicated the importance of collaboration in terms of retention. They found that new teachers who had common planning time with same-subject teachers or who participated in regularly scheduled instructional collaboration with other teachers were less likely to leave teaching.

In light of the evidence that teachers learn on the job, it is not surprising that researchers have found that collaboration and learning communities influence not just retention, but also teachers' learning and teaching practices. Rosenholtz (1989) described collaborative settings as stressing norms of continuous improvement as a collective enterprise. She noted that collaboration is especially critical for new teachers, because collaboration enabled new teachers to build a portfolio of teaching strategies to meet the individual needs of students. Based on survey data from over 1,000 teachers in eight districts in Tennessee, Rosenholtz found that collaboration has a significant direct effect on teachers' learning opportunities, defined as "the extent to which the social organization of schools poses restraints or opportunities for professional development" (Rosenholtz, 1989, p. 71).

A few recent quantitative studies support these findings. Youngs, Frank, and Pogodzinski (2012) found that collegial interaction influences novice teachers' instructional practice. The authors analyzed two rounds of survey data from 183 novice teachers in 11 districts and found that novices' teaching of higher-order comprehension skills increases more, on average, among novices who frequently interact with formal mentors regarding curriculum, teaching strategies, and student assessment. In addition, novices who had regular discussions with colleagues (other than mentors) about these topics had a lower frequency of basic skills instruction, on average, than novices who do not have such discussions. Drawing on survey data from 452 teachers in 47 elementary schools and achievement data from 2,536 students in one large midwestern school district, Goddard, Goddard, and Tschannen-Moran (2007) found that fourth grade students have higher achievement in mathematics and reading when they attend schools characterized by higher levels of teacher collaboration for school improvement. Specifically, compared to schools with average teacher collaboration, schools with a one-

standard-deviation higher-than-average teacher collaboration on school improvement had 0.08 standard deviation higher-than-average school mathematics achievement and 0.07 standard deviation higher-than-average school reading achievement.

Kardos, Johnson, Peske, Kauffman, and Liu's (2001) collected interview data from 50 first-year and second-year teachers in a wide range of Massachusetts public-school settings and conducted a qualitative analysis of novice teachers' perceptions of professional cultures in schools. The authors revealed that in some schools, little interaction occurred between experienced and less experience teachers. Johnson and Kardos (2004) noted the persistence of "sink or swim" paradigms in schools (p. 139), where teachers work in what Rosenholtz (1989) called "isolated settings" with "norms of self-reliance" (p. 44). Other schools have cultures in which new teachers are provided with sustained support and have frequent exchanges with colleagues across experience levels (Kardos et al., 2001). Johnson and Kardos (2004) contended that new teachers are more likely to feel successful in their work when situated in schools with a strong professional culture.

*Quality of Colleagues.* If teachers do, in fact, learn from their colleagues, it is reasonable to hypothesize that how much teachers learn might depend on the quality of those colleagues. In a study in which the researchers examined longitudinal data on all students in grades three through five in North Carolina between 1995 and 2006, Jackson and Bruegmann (2009) found that students' test score gains were greater when their teachers' colleagues are more effective. Specifically, they found that teachers performed better when the quality of their peers improves within the same school over time. The authors noted that these spillover effects are strongest for first-year teachers. In another study, Youngs, Frank, and Pogodzinski (2012) found that novices

are more likely to teach basic skills more regularly when their close colleagues do so. These findings suggest that new teachers' practices and their effectiveness are shaped to some extent by the practices and the quality of their colleagues.

*Data Use and Strategic Decision-Making.* Many educational experts are promoting ongoing analysis of data as part of a feedback loop to support a cycle of continuous improvement. The theory of action underlying the push to use data is that data use may enable teachers to make informed decisions about how to improve student achievement (Datnow, Park, & Kennedy-Lewis, 2012). Data analysis can help teachers identify areas of the curriculum that their students need to review and provide guidance for instructional planning. Thus, this practice may increase the amount of instructional time that is targeted towards students' needs, resulting in more efficient and productive use of class time (Hamilton et al., 2009; Mandinach & Honey, 2008).

While "data use" often brings to mind analysis of standardized student test scores, it can also involve the analysis of less formal data, such as information regarding classroom instruction (City, Kagle & Teoh, 2005) or interim assessments. Because information from these sources can be obtained throughout the year, it may be helpful for novice teachers as they learn on the job. Johnson et al. (2001, 2004) find that many new teachers seek information about their performance. As one teacher said, "I need someone to come in and to give some really concrete feedback" (Johnson et al., 2004, p. 101). New teachers expressed disappointment when they were not observed and offered advice; others who were provided ongoing supervision appreciated the feedback. Blanc et al. (2010) note that information gleaned from interim

assessments may contribute to instructional improvement, but that to be effective such assessments must be embedded in a robust feedback system.

While research on the efficacy of data use—particularly as it pertains to new teachers’ development—is limited, several qualitative case studies shed light on how data are being used and provide recommendations on data use. In one such qualitative case study, Datnow, Park and Kennedy-Lewis (2012) find that the process of teachers’ attempts to make sense of data and use this information to inform decision making is complex and is influenced by social interactions within schools. Understanding the most effective ways of using data requires unpacking the effects of these different patterns of interactions around data. While the Institute of Education Sciences has issued a practice guide on using data to support instructional decision making, the authors acknowledge that for all five recommendations made in the guide, the level of evidence is low by What Works Clearinghouse standards (Hamilton et al., 2009); relatively little empirical work has specifically investigated the effectiveness of using data to support instruction.

### **Current Study**

Previous qualitative studies suggest that new teachers rely heavily on colleagues and administrators for support and feedback. Given these findings, researchers might hypothesize that within a school, the strength of social ties and the exchange of social capital among educators influence novice teachers’ effectiveness. Yet to date, few large-scale quantitative studies have explored the issue of how working conditions and the social organization of schools might shape novice teachers’ initial effectiveness and their rate of growth in effectiveness over time. This study helps to fill that gap in the literature; it seeks to explore the variations in the interpersonal resources and support available to teachers as they gain experience and determine whether such resources and support explain changes in effectiveness among new teachers.

While prior studies have explored the relationship between school working conditions and school-wide achievement growth (Johnson, Kraft & Papay, 2012; Ladd, 2009), these studies have not explicitly modeled teacher effectiveness. In studies that use school-wide achievement growth as the outcome, it is possible that relationships between working conditions and school-wide achievement growth reflect changes in staffing that favor schools with better working conditions rather than changes in the effectiveness of teachers in the school. That is, the school may have attracted more effective teachers as a result of positive working conditions, or vice versa. I use teacher value-added scores as the outcome, and include each teacher's prior value-added score, to strengthen inferences regarding whether working conditions influence changes in teacher effectiveness. Thus, the results are less likely to be biased by confounding mechanisms.

Furthermore, while most prior studies of teachers' working conditions rely on survey data of teachers' perceptions, I am able to make use of external review data regarding key aspects of the school working environment. As Ladd (2009) notes, ideally it would be useful to compare teacher perceptions of school working conditions to the perceptions of external evaluators who conduct a "systematic evaluation of school working conditions using a protocol that is identical across schools" (p. 9). Whereas the teacher perceptions are susceptible to attribution bias—if, for example, ineffective teachers were systematically more likely to rate their schools poorly as an explanation for their own ineffectiveness—NYC Quality Review data are obtained through a uniform rubric used by external evaluators. Though survey and rubric data capture somewhat different constructs, the addition of the rubric data serves as a check on the robustness of results.

Building on this literature, I explored a variety of working conditions hypothesized to be related to novice teachers' effectiveness. The specific research questions include:

1. Do new teachers experience growth in effectiveness in the early years of teaching?
2. Are school contextual factors, such as average demographic characteristics of students, related to changes in teachers' effectiveness?
3. What aspects of teachers' working conditions enhance or inhibit novice teachers' changes in effectiveness?
4. Are the relationships between working conditions and changes in effectiveness moderated by school context? Are relationships between working conditions and changes in effectiveness moderated by other working conditions?

I portray the conceptual framework in Figure 4.1, and describe this framework below.

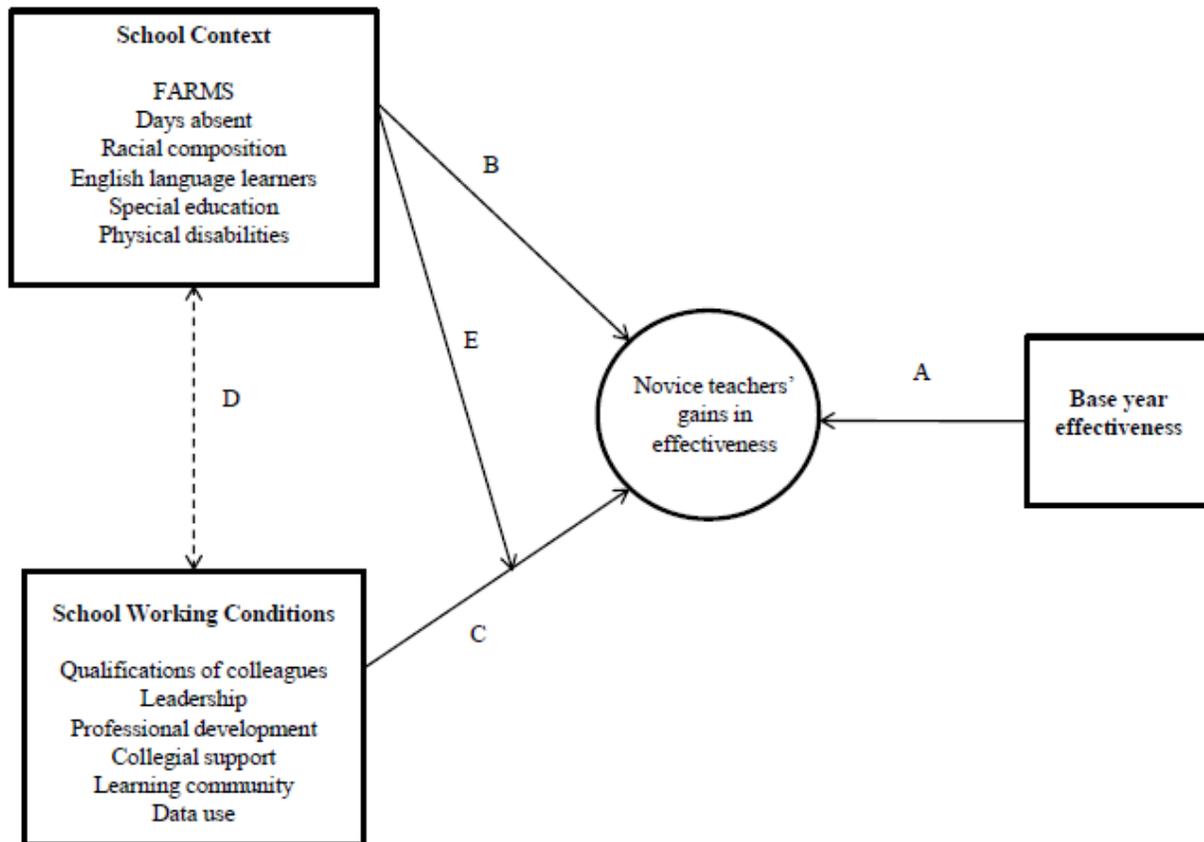


Figure 4.1. Multilevel heuristic model relating working conditions to novice teachers' effectiveness.

In the conceptual model in Figure 4.1, I depict a direct relationship between teachers' effectiveness in the first year in which they are observed and their effectiveness in the second year in which they are observed (arrow A). I hypothesize that this relationship will be positive

and significant: teachers who are more effective than average in the base year are expected to be more effective than average in the following year. Moreover, I hypothesize that gains in teacher effectiveness, as measured by changes in effectiveness between the base year and the subsequent year of teaching, will vary between schools. This portion of the model addresses the first research question.

Arrow B represents a hypothesized direct relationship between school context and novice teachers' initial effectiveness. Thus, I address the second research question in the analytic results related to arrow B. I also hypothesize that, even after controlling for prior year effectiveness, working conditions influence novice teachers' effectiveness (arrow C). The specific working conditions include *qualifications of colleagues, leadership, professional development, collegial support, learning community, and data use*. I aggregated relevant variables measured at the teacher level across all teachers within schools to construct measures of the average levels of support and teacher experience for schools in the analytic sample. To more fully capture working conditions at schools, I include a series of variables collected by external reviewers that also reports the use (or non-use) of data to guide programmatic and instructional decisions. I address research question three in the analytic results pertaining to arrow C.

I include arrow D to denote the potential multicollinearity between teachers' working conditions and school context. Finally, I use arrow E to represent the possibility that school contextual factors moderate the influence of teacher working conditions on gains in teacher effectiveness. I address part of the fourth research question in the analytic results related to arrow E. To more fully investigate this question, I also consider interactions between working conditions—that is, that specific combinations of working conditions have stronger or weaker

relationships to changes in teacher performance than would be predicted by their individual relationships.

### **Data Sources**

The dependent variables in these models are derived from annual student achievement exams given to almost all New York City students in third through eighth grade. Specifically, I used the data from grades three, four, and five to construct value-added estimates for fourth and fifth grade teachers. I limit the analysis to these grades because elementary school students are most likely to be linked to a single classroom teacher and because the value-added model requires a pre-test score (for fourth graders, this is the third grade score). The student data, provided by the New York City Department of Education (NYCDOE), consisted of a demographic data file and an exam data file for each year from 2006-2007 through 2010-2011. Demographic files included measures of gender, ethnicity, language spoken at home, free-lunch status, special-education status, and number of absences for each student in grades three through eight for a given year. For most years, the data included scores for approximately 65,000 to 80,000 students in each grade.

Using these data, I constructed a set of records with a student's current exam score and his or her lagged exam score. For this purpose, I considered a student to have value added information in cases where a student had a score in English language arts (ELA) or mathematics for the current year and a score for the same subject in the immediately preceding year for the immediately preceding grade. In keeping with Boyd et al. (2008), I excluded cases in which a student took a test for the same grade two years in a row, or where a student skipped a grade; further, I excluded observations for classrooms with fewer than ten or more than 50 students.

I further limited the data set to relatively new teachers—those in their third or earlier year in the district—because prior research suggested that novice teachers, who are on average less effective than veteran teachers and who experience the greatest returns to additional years of experience, may be particularly influenced by working conditions. I also restricted the data set to teachers with value-added estimates in adjacent years. Although these choices confine generalizability to teachers who taught fourth or fifth grade for two years, the restrictions are necessary because the goal was to explore how novice teachers’ value-added scores change as they gain experience, and to what extent working conditions are related to these changes in effectiveness. Controlling for prior value-added bolsters the strength of the research design, because estimates from nonrandomized studies that control for prior measures of the outcome variable more closely approximate estimates from randomized experiments (Cook, Shadish, & Wong, 2008; Shadish, Clark, & Steiner, 2008). The analytic sample thus included 964 teachers in 428 schools—on average, just over two early career teachers per school. The implications of this limited within-school sample size are discussed in the next section.

### **Measures**

The various data sources and the psychometric properties of assessments, constructs and measures are described thoroughly earlier in this document. Table 4.1 provides an overview; see chapter three for details.

Table 4.1 Overview of Measures

		Description
<i>School Context</i>		
FARMS	Standardized proportion of students eligible for free or reduced meals (a z-score [M=0, SD=1])	
Days absent	School aggregate of number of days absent of students in the study	
Minority	Dummy-coded indicator of whether the school had a high proportion of minority students (1 = over 90% minority; 0 if 90% or fewer)	
ELL	Dummy-coded indicator of whether the school had a high proportion of English language learners (1 = 12% or higher; 0 if less than 12%)	
Special education	Dummy-coded indicator of whether the school had a high proportion of special education students (1 = 12% or higher; 0 if less than 12%)	
Physically disabled	Dummy-coded indicator of whether the school had a high proportion of students with physical disabilities (1 = 3% or higher; 0 if less than 3%)	
<i>NYC School Survey: teachers' perceptions of:</i>		<i># Items</i>
Leadership	Support from school leaders	15
Professional development	The quality of professional development	3
Collegial support	Support from and collaboration with peers	5
<i>Quality Review: external reviewers' ratings of:</i>		
Instructional coherence	Extent to which school has a strategy to align decisions regarding curriculum, instruction, and organization	4
Analyze data	School's consistency in gathering, analyzing, and sharing information on student learning outcomes	4
Plan/set goals	Extent to which school leaders and staff use data to set and track high goals for learning	4
Capacity building	Extent to which the school aligned its leadership development and structured professional collaboration around meeting the school's goals	4
Monitor/revise	School's structures for monitoring and evaluating progress and revising plans and practices to meet goals	4
Quality Review	Average of all five Quality Review constructs	20

As indicated previously, I use the term “teacher effectiveness” as shorthand for a “value-added” concept of successful teaching. In this study, I explore some working conditions not considered in the previous study: veteran teachers’ value-added estimates as a proxy for collegial qualifications and teachers’ perceptions of the school as a learning community.

To create a proxy for collegial qualifications, I aggregated the English language arts and mathematics value-added scores of teachers with three or more years of experience to the school

level. In English language arts, school average values ranged from -0.32 to 0.34 with a mean of approximately 0 and SD of 0.07. In mathematics, school average values ranged from -0.52 to 0.44 with a mean of approximately 0 and a SD of 0.13. In both subjects, the school aggregate of veteran teachers' value-added estimates is normally distributed.

I used data from the School Survey to create a scale indicating teachers' perceptions of whether the school has a learning community, or what Rosenholtz (1989) refers to as norms of continuous improvement. I created this variable through principal components factor analysis of nine items (see Appendix B for details) and standardized to a mean of 0 and standard deviation of 1. Representative items from the learning communities scale include whether "people in this school are eager to share information about what does and doesn't work," and "this school frequently tries out new instructional practices or strategies." Teachers rated survey items along a four-point continuum of strongly agree to strongly disagree; responses were reverse coded so that higher values represent greater agreement with these statements. The aggregate of the learning community factor is normally distributed. The coefficient of reliability (alpha) is 0.94 to 0.99.<sup>31</sup>

### **Analytic Approach**

Following Atteberry, Loeb, and Wyckoff (2012), I first created the outcome measures by estimating teachers' yearly value-added scores for each teacher in each of the three years included in the study (2007-2008, 2008-2009, and 2009-2010). This measure served as an estimate of a teacher's ability to stimulate test score gains, a proxy for his or her effectiveness.

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<sup>31</sup> I created separate factor scores for each year of survey data; the items for the learning community factor were only on the surveys in 2008-2009 and 2009-2010. The Cronbach's alpha provided is the range across years for the scores created at the teacher level. Factor scores were then aggregated to the school level.

To create this measure, I used a two-level model with students within teachers. I fitted these multilevel regressions separately for each combination of grade, subject, and year.<sup>32</sup>

$$Y_{it} = \beta_{0t} + \beta_{1i}(PriorAch) + \beta_{2i}(PriorAchOther) + \beta_{3i}(X) + r_{it} \quad [4.1a]$$

$$\beta_{0t} = \gamma_{00} + \gamma_{01}(C) + u_{0t} \quad [4.1b]$$

Here, the level-1 model specified achievement  $Y$  of student  $i$ , with teacher  $t$  as a function of a vector of prior achievement in the same subject and in the other subject (mathematics or English language arts), as well as a vector  $X$  of the student's characteristics (gender, ELL and special education status, and whether eligible for free or reduced meals). The level-2 model controlled for a vector  $C$  of classroom characteristics (aggregates of the students' prior achievement and student characteristics) and grade. I saved the residuals and averaged the residuals across all students in the same class to create a value-added score, or indicator of effectiveness, for a teacher in a given school year.

I used two-level models (teachers within schools) to explore changes in teachers' effectiveness with an additional year of experience. With an unconditional two-level model, I examined whether novice teachers' effectiveness varies across schools. I calculated the proportion of variance in new teachers' effectiveness that can be explained by school-level factors before continuing to the next step. I then developed conditional models. Prior to examining the relationship between school characteristics and teachers' gains in effectiveness, I developed the conditional level-1 model. In addition to base-year value added estimates, I included controls for whether teachers were in their second or third year of working in the district during the base year. Thus, the reference group consisted of teachers in their first year of working in the district. I also included an indicator of whether the base year was 2009 (thus,

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<sup>32</sup> I fitted the regressions separately by grade in part because the New York state assessments are not on a vertical scale; thus, the scale scores are comparable within each grade level but not across grades (CTB/McGraw-Hill, 2009).

teachers whose base year is 2008 was the reference group). Finally, I included an indicator of whether the teacher was part of the NYC teaching fellows or Teach for America, because these programs may offer ongoing support that could confound results. I grand-mean centered all level-1 variables. The equation for the level-1 model is:

$$Y_{ij} = \beta_{0j} + \beta_{1i}(BaseVA) + \beta_{2i}(Year2) + \beta_{3i}(Year3) + \beta_{4i}(2009) + \beta_{5i}(TFA/Fellow) + r_{ij} \quad [4.2]$$

In equation 4.2,  $Y_{ij}$  is the effectiveness of teacher  $i$  in school  $j$ ;  $\beta_{0j}$  is the average effectiveness of novice teachers in school  $j$ ;  $\beta_{1j}$  represents the relationship between base-year effectiveness and teacher's effectiveness in the subsequent year;  $\beta_{2j}$  is the increment/decrement to teacher's effectiveness for those in their second year of teaching during the base year;  $\beta_{3j}$  is the increment/decrement to teacher's effectiveness for those in their third year of teaching during the base year;  $\beta_{4j}$  is the increment/decrement to teacher's effectiveness for teachers whose base year was 2008-2009;  $\beta_{5j}$  is the increment/decrement to teacher's effectiveness for those who entered teaching through Teach for America or Teaching Fellows;  $r_{ij}$  is the random error or unique effect that represents the deviation of effectiveness for teacher  $i$  in school  $j$  from its predicted value.

In the level-2 model, I modeled novice teachers' value-added estimates as a function of the grand mean across teachers in school  $j$ . The level-2 equation takes the following form for the fully conditional level-1 model:

$$\beta_{0j} = \gamma_{00} + u_{0j} \quad [4.3]$$

Where  $\beta_{0j}$  is the average effectiveness of novice teachers in school  $j$ ;  $\gamma_{00}$  is the average effectiveness of novice teachers across all schools; and  $u_{0j}$  is the random error or unique effect that represents the deviation of effectiveness for school  $j$  from its predicted value.

In theory, multilevel modeling offers researchers an opportunity to explore more sophisticated conceptualizations of the phenomena of interest. For example, here I explored variation in new teachers' value-added scores across schools, but I could also have explored variation in the relationships between independent variables (such as prior-year value-added) and new teachers' value-added scores across schools: a slopes-as-outcome model (Raudenbush & Bryk, 2002). This investigation would be consistent with a hypothesis that teachers' prior value-added scores are a stronger predictor of current value-added scores in some schools and a weaker predictor in other schools. In practice, however, the available data are not always sufficient to explore such theories. In this case, the small number of new teachers per school limited the number of random effects that could be estimated (McCoach, 2010). Because of the small number of teachers within schools, I opted to fix all level-1 predictors for the main set of analyses.

In this next step, to address the second research question regarding the relationship between school context and teachers' effectiveness, I proceeded to build a conditional level-2 model that uses aggregated school demographic characteristics to predict the intercept. Specifically, the set of predictors I added situated novice teachers' value-added scores as a function of the grand mean of novice teachers' value-added across schools, plus some increment or decrement to value-added estimates associated with the proportion of students eligible for FARMs, proportion of English language learners, average number of days students are absent, and indicators of whether the school had high proportions of minority, special education, and

physically disabled students. I included these variables primarily as statistical controls for school context.

The third research question is based on the hypothesis that that teachers' working conditions predict school averages of novice teachers' value-added scores ( $\beta_0$ ), after controlling for their value-added scores in the prior year. To address this question, I posed the following level-2 equation to model the intercept:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\textit{Context})_j + \gamma_{02}(\textit{Colleagues})_j + \gamma_{03}(\textit{Survey})_j + \gamma_{04}(\textit{QR})_j + u_{0j} \quad [4.4]$$

Where  $\beta_{0j}$  is the average teacher value added estimate in school  $j$ ,  $\gamma_{00}$  is the average teacher value added across all schools, *Context* is a vector of aggregate school characteristics, such percentage of free-lunch and minority students within school  $j$ ; *Colleagues* is a vector of variables that includes two dichotomous indicators of whether the school has high or low proportions of experienced teachers and the aggregate value-added scores of veteran teachers in school  $j$ ; *Survey* is a vector of factor scores from the school survey, including teachers' perceptions of quality of school leadership in professional development, collegial support, and learning community in school  $j$ ; *QR* is the average of the five factor scores that rate instructional coherence, analysis of data, planning and goal setting, capacity building, and monitoring and revision in school  $j$ ; and  $u_{0j}$  is the level-2 random effect. I expected this model to shed light on whether teachers' working conditions are related to average value-added scores of novice teachers.

To examine the final research question, I added to this model a series of possible interactions between school poverty and working conditions. In equation 4.5a,  $\beta_{0j}$  is the average

teacher value added estimate in school  $j$ ,  $\gamma_{00}$  is the average teacher value added across all schools,  $Context$  is a vector of aggregate school characteristics, such as indicators of whether school  $j$  has a high proportion of special education students;  $FARMS$  is the percentage of free-lunch and minority students;  $WC$  is a specific working condition in school  $j$ ; and  $FARMS*WC$  is the product of the percentage of free-lunch and minority students and the working condition in question.

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(Context)_j + \gamma_{02}(FARMS)_j + \gamma_{03}(WC)_j + \gamma_{04}(FARMS * WC)_j + u_{0j} \quad [4.5a]$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(Context)_j + \gamma_{02}(WC1)_j + \gamma_{03}(WC2)_j + \gamma_{04}(WC1 * WC2)_j + u_{0j} \quad [4.5b]$$

Equation 4.5b is similar, except that instead of an interaction between the percentage of free-lunch and minority students and a working condition, it includes an interaction between two working conditions.

All data preparation was done using SPSS, and multilevel analyses were conducted with HLM Version 7 (Raudenbush, Bryk & Congdon, 2010). I used full maximum likelihood estimation, which is preferable to restricted maximum likelihood because it allows for additional tests of model fit (McCoach, 2010). In the following section, I present descriptive and analytic results. In the descriptive results, I provide details on the characteristics of teachers and schools in the sample. I present the analytic results in the order in which the multilevel model was built: first, the results of the fully unconditional models, followed by the results of the level-1 models which introduce teacher characteristics, and then the results of the level-2 (between-school) models. I follow the practice of other researchers using multilevel modeling and set the criterion

for statistical significance at  $p < 0.10$  (Lee & Burkam, 2003). This is an appropriate practice when the primary purpose of an analysis is exploratory and statistical power is weak.

### **Results**

In Table 4.2, I present the overall descriptive statistics for early career teachers and their schools. I report outcome and teacher variables at the teacher level whereas the remainder of the variables are reported at the school level. In the columns, I provide means and percentages for all cases, cases associated with low free and reduced price meals enrollment (lowest quintile) and high free and reduced price meals enrollment (highest quintile). In the final column, I present the resulting of statistical tests that compare differences in means or percentages for the latter two columns.

Base-year and post-year value-added estimates are not significantly different between the wealthiest (low FARMS) and poorest (high FARMS) schools in New York City. In this sample, wealthier and poorer schools have similar proportions of early career teachers in their second or third (as opposed to first) year of teaching. The only significant difference among the teacher characteristics included in Table 4.1 is that in schools serving less wealthy students, 13 percent of early career teachers are from Teaching Fellows or Teach for America, whereas in wealthier schools just two percent of novice teachers are from these programs.

Table 4.2 Descriptive Statistics of Outcomes and Predictors from Final Analytic Sample

	Overall		Free and Reduced Meals (FARMS)			
			<i>Low FARMS</i>		<i>High FARMS</i>	
<i>Outcomes</i>	<i>Mean</i>	<i>(SD)</i>	<i>Mean</i>	<i>(SD)</i>	<i>Mean</i>	<i>(SD)</i>
Post year ELA	-0.004	(0.158)	0.007	(0.179)	0.010	(0.157)
Post year Math	0.010	(0.276)	0.044	(0.291)	0.004	(0.292)
<i>Teacher Variables</i>						
Base year ELA	-0.021	(0.146)	-0.011	(0.157)	-0.014	(0.132)
Base year Math	-0.009	(0.211)	-0.007	(0.204)	-0.004	(0.217)
Base year = 2009	33%		31%		35%	
2 <sup>nd</sup> year teachers	31%		35%		34%	
3 <sup>rd</sup> year teachers	33%		36%		32%	
Teaching Fellows or TFA	6%		2%		13%	***
<i>School Context</i>						
Days absent	11.062	(2.045)	9.671	(2.019)	12.547	(1.799) ***
FARMS	62%		33%		89%	***
Minority	85%		73%		96%	***
ELL	15%		12%		21%	***
Special education	12%		11%		13%	**
Physically disabled	3%		3%		4%	
<i>Working Conditions</i>						
Experienced teachers	68%		71%		63%	
Leadership	-0.004	(0.850)	0.111	(0.849)	-0.222	(0.837) ~
Professional development	0.002	(0.954)	0.176	(0.855)	-0.259	(1.080) *
Collegial support	0.001	(0.916)	0.267	(0.929)	-0.206	(0.850) **
Learning community	0.009	(0.948)	-0.179	(0.987)	0.137	(0.908)
Instructional coherence	0.093	(0.958)	0.036	(1.097)	0.071	(0.984)
Analyze data	0.072	(0.946)	0.145	(1.058)	-0.013	(0.878)
Plan & set goals	0.109	(0.983)	0.317	(0.911)	-0.060	(0.926) ~
Capacity building	0.091	(0.983)	0.176	(0.956)	0.032	(0.999)
Monitor & revise	0.090	(0.982)	0.130	(0.944)	0.063	(1.038)
Number of Schools	428		94		87	
Number of Teachers	964		211		200	

*Note.* Top and bottom quintiles of schools based on proportion of students eligible for free or reduced price meals are represented: in the top quintile (high FARMS) 81.59 percent or greater are eligible; in the bottom quintile (low FARMS) 44.55 percent or fewer are eligible. I used ANOVA to determine means for highest and lowest quintiles and Tamhane's T2 post-hoc test, which does not assume equal variances, to assess significance of differences.

Wealthier and poorer schools served significantly different student populations, as seen in Table 4.2. By definition wealthier schools had fewer FARMS students (33 percent) than poorer schools (89 percent). Wealthier schools also had fewer student absences on average (about ten days v. 13 days) and lower enrollments of English language learners (12 percent v. 21 percent) and special education students (11 percent v. 13 percent). Schools that served more high-income students had lower enrollments of minority students; 73 percent of students in wealthier schools are members of minority groups compared to 96 percent of students in the least wealthy schools.

Compared to schools serving fewer low-income students, in schools serving higher proportions of low-income students, teachers have less positive perceptions of the quality of leadership, professional development, and collegial support. These differences range from a third of a standard deviation for school leadership to nearly half a standard deviation for collegial support. Among the Quality Review constructs, the patterns are similar: in schools serving more low-income students, Quality Review ratings are lower. However, the differences are only statistically significant for one construct—planning and setting goals. External reviewers rate wealthier schools over a third of a standard deviation higher than schools serving more low-income students in terms of use of data to plan and set goals.

#### *New teachers' growth in effectiveness in the early years of teaching: variation across schools*

As I explained earlier, I estimated value added scores by regressing students' current year achievement on prior year achievement and student characteristics, and aggregated the residuals to the teacher level. I examined these valued-added scores for first-, second- and third-year teachers. On average, new teachers in this study did experience growth in effectiveness during the early years of teaching. In Figure 4.2, I demonstrate this pattern. The average value-added

estimates of teachers who were in the first year of teaching during their base year is lower than that of teachers in their second year of teaching; second-year teachers have lower average value-added estimates than third-year teachers. In both English language arts and mathematics, regardless of whether they are first, second or third year teachers, teachers' value-added estimates in the base year are lower than their value-added estimates in the post year.

Improvement in effectiveness appears most dramatic among teachers who had been in their first year of teaching during the base year, but teachers who had been in their second and third years also appear to improve between the base year and post year. The correlation between base-year and post-year value-added scores in English language arts is 0.24; the correlation in mathematics is 0.34. These findings are consistent with prior literature on value-added (c.f. Glazerman, Loeb, et al., 2010).

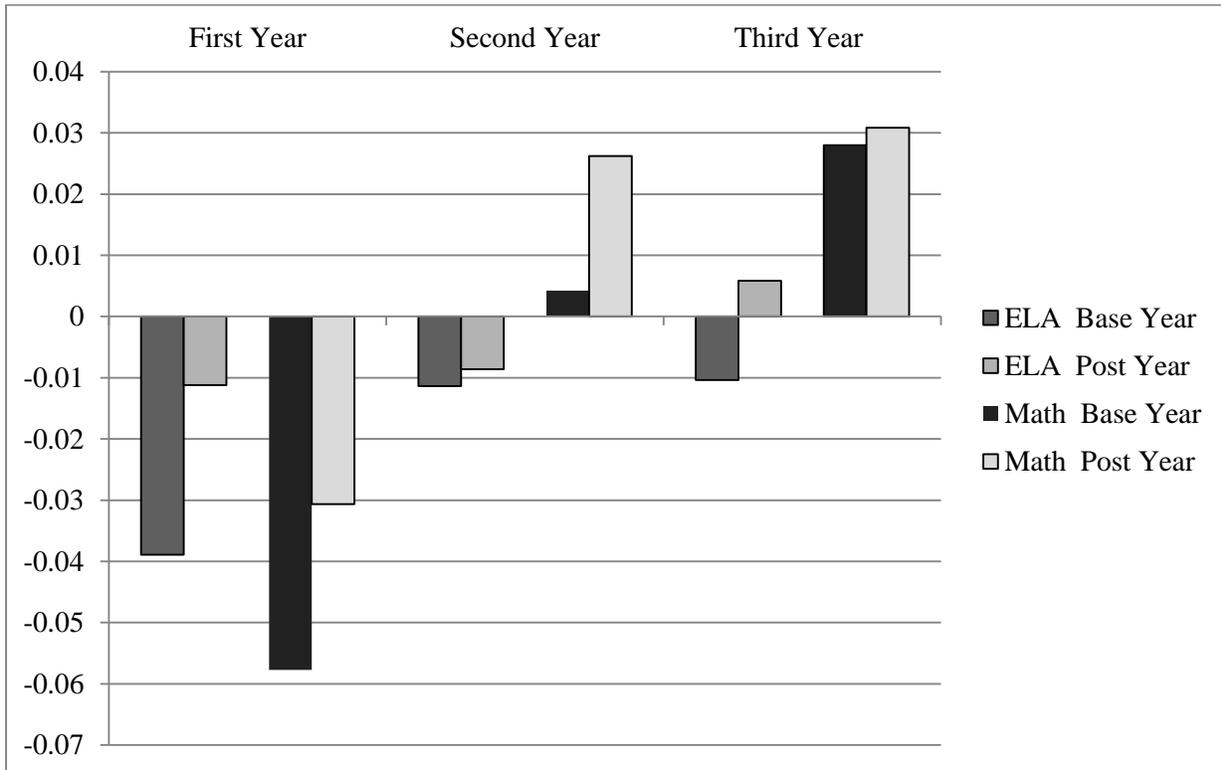


Figure 4.2. Novice teachers' changes in effectiveness.

Average value-added scores also vary significantly between schools; this significant variation provides empirical justification for examining whether these scores vary as a function of teacher working conditions. In Table 4.3, I display the results of the fully unconditional model, including the intraclass correlation coefficient, which represents the proportion of variance in the outcomes that is between schools. As expected, novice teachers' effectiveness varies significantly across schools. Approximately 12 percent of the variation in new teachers' English language arts value-added estimates is across schools, while about 17 percent of variation in new teachers' mathematics value-added estimates is across schools. Since the proportion of variance across schools is statistically significant, these results provided empirical justification for a multilevel modeling approach. However, Table 4.3 also indicates low levels of reliability in the estimate of average teacher effectiveness for schools, due largely to the small sample size within schools. As a result, statistical tests may be biased toward the null hypothesis, even when using a criterion of  $p < .10$ .

Table 4.3 Intraclass Correlation Coefficients and Reliability, by Subject

Outcome	$\sigma^2$	$\tau$	$\tau / (\tau + \sigma^2)$	$\lambda$
ELA value-added score	0.883	0.117	11.67%	0.214
Mathematics value-added score	0.830	0.171	17.08%	0.292

To better understand teacher effectiveness across teachers and across schools, I developed a level-1 model that included base-year value added estimates along controls for other relevant teacher characteristics. Because experience is hypothesized to predict teacher effectiveness, I included dichotomous indicators of whether the teacher was in his or her second or third year during the base year. I also included an indicator of whether the base year was 2009 (with 2008 as the reference group) to account for potential differences in the quality of novice teachers in the labor market between these two years. Finally, I included an indicator of whether

the teacher was part of the NYC teaching fellows or Teach for America, because these programs may offer ongoing support that could confound results. All variables were grand-mean centered so as to control for differences across schools in these factors.

Using this model, I estimated the change in teachers' effectiveness between two years by regressing post year value added estimates on base-year value-added estimates within schools. I report the results in Table 4.4 for English language arts (second column) and mathematics (third column). The last two rows of the table report the remaining variance between schools in the outcome after considering the all the variables in the model and the reliability in the estimate of school average teacher valued added after controlling for teacher characteristics.

Table 4.4 Within-School Models: Novice Teacher Characteristics and Gains in Effectiveness

	ELA		Mathematics	
	Coefficient	(SE)	Coefficient	(SE)
Intercept	0.002	(0.034)	-0.006	(0.033)
Base year value-added score	0.233	(0.031) ***	0.319	(0.040) ***
2 <sup>nd</sup> year teacher	-0.027	(0.078)	0.042	(0.076)
3 <sup>rd</sup> year teacher	0.091	(0.077)	0.057	(0.075)
Base year 2009	-0.127	(0.067) ~	-0.189	(0.082) **
Teaching fellow/TFA	0.049	(0.137)	-0.065	(0.142)
<i>Variance component</i>	0.089	***	0.099	***
<i>Reliability</i>	0.181		0.209	

Note. All variables grand-mean centered and fixed.

In general, I find a strong positive relationship between teachers' effectiveness in the base year and their effectiveness in the subsequent year. This finding suggests that effective teachers remain effective and less effective teachers remain less effective, which is consistent with prior literature in which initial effectiveness is a significant predictor of same-subject effectiveness in subsequent years (Glazerman, Loeb, et al., 2010). On average, I find that a one standard deviation increase in a teacher's base-year value-added estimate is associated with an increase in

the estimate of post-year value added of 0.23 standard deviations in English language arts and 0.32 standard deviations in mathematics. Since most of the control variables do not have significant relationships with the outcomes, it is not surprising to find that these results are very similar to the simple correlations between base-year and post-year value-added estimates reported earlier.

In English language arts, the relationship between value-added scores in the base year and the subsequent year varies significantly across schools. That is, the relationship is positive on average but not consistent; it may be a strong positive relationship in some schools and close to nonexistent in others. Due to the very small number of teachers per school in the final sample, allowing this relationship to vary results in a loss of degrees of freedom and statistical power. For this reason, I fixed the relationship between base year and post year value-added estimates to be consistent across schools for the subsequent analyses.

Table 4.5 Estimation of Within-School Variance Explained by Level-1 Models

Outcome	$\sigma_{FUM}^2$	$\sigma_{L1}^2$	Explained by Level-1	$\tau_{FUM}$	$\tau_{L1}$	Explained by Level-1
ELA value-added score	0.883	0.847	4.1%	0.117	0.089	23.3%
Mathematics value-added score	0.830	0.776	6.5%	0.171	0.099	41.9%

As seen in Table 4.5, the fully conditional level-1 model only explains a small proportion of the variance in novice teachers' value-added within schools.<sup>33</sup> Because I grand-mean centered all level-1 variables in these models, the models control for differences across schools in base-year value added estimates of novice teachers as well as differences across schools in the proportion of novice teachers who are in the second or third year of teaching in the district.

<sup>33</sup> Proportion of variance explained is derived from the equation:  $\sigma_{FUM}^2 - \sigma_{L1}^2 / \sigma_{FUM}^2$

These variables (base-year value added estimates, cohort, year of teaching, and whether in Teaching Fellows or Teach for America) explain 23 percent of the between-school differences in average effectiveness of novice teachers in English language arts, and 42 percent of the between-school differences in average effectiveness in mathematics of novice teachers. Because the base-year valued added estimate is the strongest predictor of the subsequent-year value added score, most of the reduction in between school variance is probably due to differences between schools in average base-year value-added scores.

### *School context and changes in teacher effectiveness*

In Table 4.6 I report the results of the level-2 model that includes school contextual factors as predictors of average teacher valued-added in English language arts (second column) and mathematics (third column). As with the last two rows in Table 4.4, the last two rows in Table 4.6 provide an estimate of the remaining variance and resulting reliability after including the level-2 variables. School contextual variables are unrelated to value-added scores in English language arts and mathematics. The lack of relationship between other school demographic characteristics is not surprising because the estimates of teacher value-added account for demographics at both the student and classroom level.

Table 4.6 Between-School Models: School Context and Novice Teacher Changes in Effectiveness

	ELA		Mathematics	
	Coefficient	(SE)	Coefficient	(SE)
Intercept	-0.014	(0.080)	-0.038	(0.078)
FARMS	0.060	(0.044)	-0.049	(0.042)
ELL	0.046	(0.070)	0.042	(0.068)
Days absent	-0.019	(0.021)	-0.030	(0.020)
Minority	-0.086	(0.089)	0.013	(0.087)
Special education	-0.007	(0.072)	0.045	(0.070)
Physically disabled	0.075	(0.069)	-0.035	(0.067)
<i>Variance component</i>	0.083 ***		0.086 ***	
<i>Reliability</i>	0.170		0.187	

*Note.* Continuous variables (FARMS and days absent) are grand-mean centered; all other variables are dichotomous and are uncentered. This model includes all level-1 predictors, grand-mean centered and fixed.

In both subjects, a statistically significant amount of between-school variation in novice teachers' value-added remains. This finding suggests that other school factors may explain differences in the effectiveness of early career teachers. Prior to continuing to the next step, I used multivariate hypothesis tests to assess the null hypothesis that the school contextual variables are zero, and was unable to reject the null hypothesis that all parameters are simultaneously zero. I then used the likelihood ratio to compare the deviance statistics from models with the full set of school demographics to more parsimonious models that excluded these variables. Based on these results, in subsequent models I removed the school contextual variables because these predictors did not contribute significantly to improved model fit.

*Working conditions and novice teachers' changes in effectiveness*

In this section, I present the results of the fully conditional level-2 models, which include both significant school context variables and working conditions. Based on the results from the prior set of analyses on school context, the English language arts models includes only one school context variable: whether the school serves a high proportion of students with physical

disabilities. The model for mathematics includes two school context variables: whether the school serves a high proportion of English language learners and special education students. Table 4.7 reports the results for the models in which I add working conditions as predictors of school average teacher effectiveness in English language arts (second column) and mathematics (third column). I discuss results first for English language arts and then for mathematics.

Contrary to expectations, novice teachers' changes in English language arts value-added are not significantly related to either veteran teachers' average value-added or to the proportion of experienced teachers in the school. Nor are new teachers' one-year gains in effectiveness in English language arts influenced by school leadership, professional development, or collegial support. However, the extent to which teachers perceive the school as a learning community—perceptions of the school as an environment in which people share information, try new instructional strategies, and are focused on improving student performance—has a positive and statistically significant relationship with teachers' improvement in English language value-added scores (at  $p < .10$ ). After controlling for prior-year value-added scores, novice teachers working in schools in which teachers' perceptions of the learning community is one standard deviation above average outperform peers in schools with average learning communities by about seven percent of a standard deviation in English language arts value-added.

Table 4.7 Between-School Models: Working Conditions and Novice Teacher Gains in Effectiveness

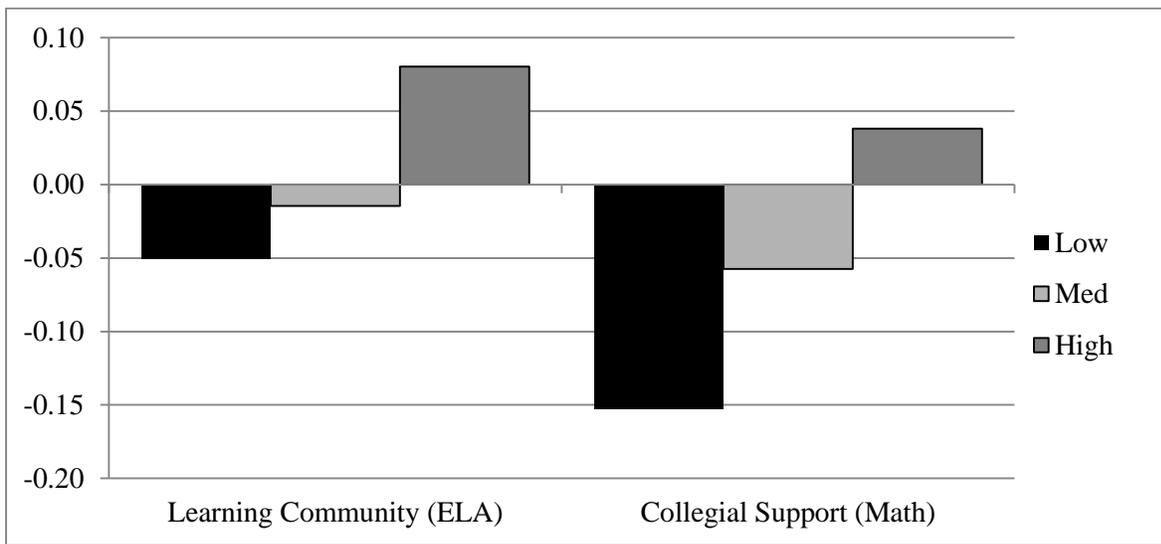
	ELA		Mathematics	
	Coefficient	(SE)	Coefficient	(SE)
Intercept	0.015	(0.061)	-0.057	(0.059)
Low experience	0.005	(0.078)	0.074	(0.075)
High experience	-0.146	(0.111)	0.039	(0.106)
Veteran value-added	-0.279	(0.565)	0.310	(0.270)
Leadership	0.045	(0.077)	0.006	(0.075)
Professional development	-0.019	(0.063)	-0.051	(0.060)
Collegial support	-0.007	(0.053)	0.096	(0.051) ~
Learning community	0.066	(0.040) ~	0.024	(0.035)
Quality review composite	0.048	(0.043)	0.078	(0.042) ~
<i>Variance component</i>	0.085	***	0.078	***
<i>Reliability</i>	0.175		0.173	

*Note.* Level-2 includes just the working conditions listed in this table. At level 1, I included all controls (grand-mean centered and fixed) regardless of significance in order to account for possible differences across schools in novice teachers' year of experience, cohort, and whether they entered teaching through Teaching Fellows or Teach for America.

~  $p < 0.10$ . \*  $p < 0.05$ . \*\*  $p < 0.01$ . \*\*\*  $p < 0.001$ .

Similar to the results for English language arts, novice teachers' gains in mathematics are not significantly related to the proportion of experienced teachers, veteran teachers' average value-added in mathematics, school leadership, or professional development once we control for prior year value-added. Nonetheless, collegial support has a positive and statistically significant relationship with novice teachers' gains in mathematics. On average, compared to novice teachers in schools with average perceptions of collegial support, novice teachers who work in schools where teachers perceived higher levels of collegial support (one standard deviation above average) have about ten percent of a standard deviation increase in effectiveness. In addition, novice teachers who work in schools with higher Quality Review ratings (one standard deviation above average) are about eight percent of a standard deviation more effective than novice teachers in schools with average Quality Review ratings.

Thus, among the school survey variables, the extent to which teachers perceive the school as being a learning community is the most relevant facet of the school environment in terms of novice teachers' development in English language arts while perceptions of collegial support are the most relevant condition in terms of mathematics. These effects are small, but they reflect the difference in value-added estimates associated with a school's working conditions over the course of just one additional year of experience. In Figure 4.4, I display the relationship between learning community and novice teachers' gains in English language arts and the relationship between collegial support and novice teachers' gains in mathematics.



*Figure 4.4.* Working conditions associated with novice teachers' gains in effectiveness.

To better understand which aspects of the Quality Review are related to outcomes, I ran a series of separate regressions for each of the five Quality Review factor scores. These models include those working condition variables determined to be significantly related to the outcomes in prior models. The results are presented in Table 4.8. I first describe the results for English language arts (the middle column), then follow with a description of the results for mathematics (the right column).

Of the five Quality Review constructs, only capacity building have a statistically significant, positive relationship with teachers’ value-added scores in English language arts. A standard deviation increase in capacity building, which encompasses professional collaboration and professional development aimed at improving learning outcomes, is associated with a six percent of a standard deviation increase in teachers’ effectiveness in English language arts.

Table 4.8 Results from Separate Regressions for Each Quality Review Construct

	ELA		Mathematics	
	Coefficient	(SE)	Coefficient	(SE)
Instructional coherence	0.047	(0.035)	0.087	(0.034) *
Analyze data	0.022	(0.037)	0.058	(0.038)
Plan & set goals	0.050	(0.035)	0.069	(0.036) *
Capacity building	0.060	(0.035)~	0.076	(0.035) *
Monitor & revise	0.009	(0.035)	0.011	(0.035)

*Note.* At level 2, each regression variables deemed significant in the previous steps (for ELA, learning community; for mathematics, collegial support). At level 1, I included all controls (grand-mean centered and fixed) regardless of significance in order to account for possible differences across schools in novice teachers’ year of experience, cohort, and whether they entered teaching through Teaching Fellows or Teach for America.  
 ~  $p < 0.10$ . \*  $p < 0.05$ . \*\*  $p < 0.01$ . \*\*\*  $p < 0.001$ .

With regard to teacher effectiveness in mathematics, capacity-building as well as two other Quality Review components have statistically significant, positive relationships with value-added scores. The other two Quality Review components that have statistically significant main effects on value-added estimates in mathematics (but not in English language arts) are instructional coherence and planning and setting goals. Instructional coherence encompasses curricular alignment to state standards and alignment of teaching practices to the curriculum, planning of academic tasks using student work and data, and alignment of resources—staff and student time as well as material resources—to improve instruction. Planning and setting goals ratings reflects school staff’s use of data to set measurable and differentiated learning goals for student subgroups and to track progress, as well as whether school staff communicate high expectations and support students to achieve those expectations. As seen in the right column in

Table 4.8, the size of the effect for the significant components ranges from about seven percent of a standard deviation increase in mathematics value-added scores for a standard deviation increase in planning and setting goals to nine percent of a standard deviation increase in mathematics value-added scores associated with a standard deviation increase in instructional coherence.

The relative strength of each of the significant Quality Review constructs in predicting novice teachers' gains in mathematics can be seen in Figure 4.5; instructional coherence and capacity building have the largest effect sizes with regard to novice teachers' value-added estimates in mathematics. Controlling for other variables in the model, including prior year value-added estimates and collegial support, the mathematics value-added estimates of novice teachers in schools rated a standard deviation above average in instructional coherence or capacity building are almost a tenth of a standard deviations higher than novice teachers in schools with average ratings on these measures ( $p < 0.01$ ). Again, though these effects are relatively small, the influence of data use and strategic decision-making on teachers' effectiveness may be cumulative. The estimates here are the effect size for just one additional year of experience.

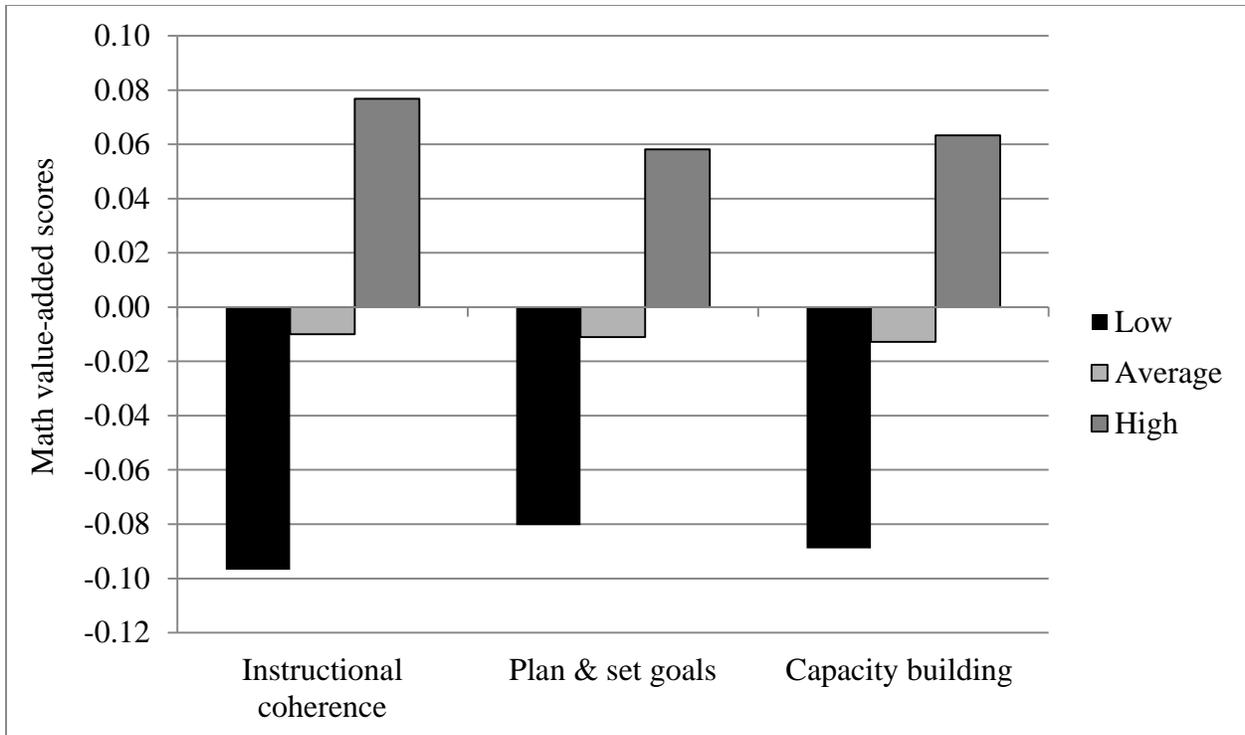


Figure 4.5. Working conditions associated with novice teachers' gains in mathematics.

Working conditions and changes in effectiveness: moderating factors

None of the interactions between working conditions and the proportion of students eligible for free or reduced meals are significant predictors of novice teachers' value-added. In other words, working conditions do not have any more or less of a relationship with novice teachers' gains in high-poverty schools than in low-poverty schools. However, I find that certain working conditions interact with each other, such that the effect of one working condition on novice teachers' gains in English language depends on the value of another working condition.<sup>34</sup> These interactions occur between the school's learning community—the extent to which the school is perceived as a place where people share information, discuss problems, and explore

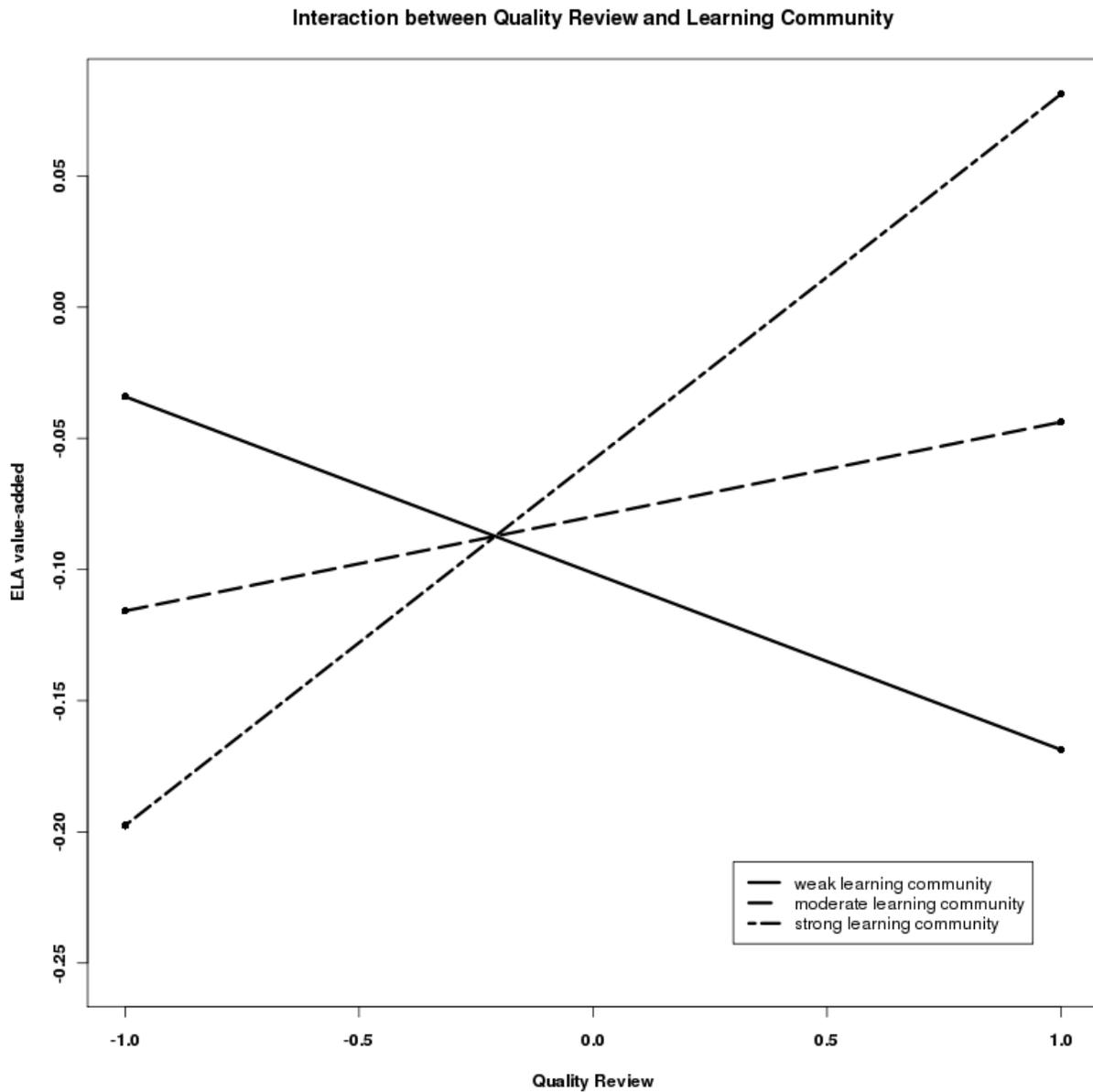
<sup>34</sup> I tested for similar interactions with regard to teacher effectiveness in mathematics. None of the interactions were statistically significant.

new ideas and instructional practices—and the Quality Review components indicating data use and strategic decision-making.<sup>35</sup>

Specifically, I find that among schools that teachers perceive as having an average learning community, teachers in schools with higher ratings on the Quality Review have greater value-added scores compared to teachers in schools with average or low ratings on the Quality Review. This positive relationship between Quality Review ratings and value-added scores is even stronger in schools with strong learning communities. But among schools with weak learning communities, teachers in schools with higher ratings on the Quality Review components actually have lower gains on average. In Figure 4.6 below, I illustrate how the interaction between a composite measure of Quality Review ratings and school learning community relates to teacher effectiveness in English language arts.

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<sup>35</sup> I tested for interactions between each of the Quality Review elements and learning community. With the exception of planning and goal setting, each of the Quality Review components had a statistically significant interaction with learning community when the outcome is value-added scores in English language arts. I focus here on the interaction between the *composite* Quality Review measure and learning community for the sake of brevity.



*Figure 4.6.* Interaction between quality review and learning community.  
*Note.* Interaction graph developed via online tools at: <http://www.quantpsy.org> (Preacher, Curran & Bauer, 2006)

Thus, in terms of influencing novice teachers’ gains in English language arts, the efficacy of school practices regarding alignment of curriculum and instruction, data analysis, planning and setting goals, building capacity, and monitoring progress and adapting plan were contingent on the school’s learning community. That is, school practices around data use have a different

relationship with novice teachers' effectiveness depending on whether teachers perceive the school as having a strong or weak learning community. From the results presented in Figure 4.6, I conclude that data use and strategic decision-making practices have a positive effect in schools with strong learning communities, though these same constructs have a negative effect on novice teachers' gains in schools with weak learning communities. This finding suggests that attention to data and organization of the school around student achievement may enhance teacher effectiveness, but might actually be detrimental to novice teachers working in schools where teachers do not share information and are not encouraged to try new ideas or instructional strategies.

Given the symmetry of the interaction, an alternative interpretation is that teachers in strong learning communities have higher value-added than peers in schools with weaker learning communities *only* when Quality Review ratings are above average or higher. That is, a strong learning community alone is insufficient to foster improvements in teacher effectiveness; the school also needs to be organized to support student achievement and use data to inform instruction and decision-making.

### **Discussion**

While several prior studies have presented evidence that teachers' working conditions are students' learning conditions (Hirsch & Emerick, 2006; Johnson, Kraft & Papay, 2012; Ladd, 2009), the findings of the current study provide some support for the notion that teachers' working conditions are also *teachers'* learning conditions, at least for early career teachers. The current study suggests that aspects of the school setting are related to teachers' changes in effectiveness between years, which is consistent with Sass et al.'s (2012) conclusion that the

effect of experience on teacher productivity may depend on the setting in which experience is acquired. Inexperienced teachers become more effective when they teach in schools with strong learning communities, with greater collegial support, and with stronger practices regarding data use and strategic decision-making. However, at least in terms of effectiveness in English language arts, these working conditions interact: teachers in schools with greater use of data and strategic decision-making are more effective *only* when teachers perceive the school as a learning community; if the school is not perceived as a learning community, greater use of data and strategic decision-making are associated with lower effectiveness in English language arts.

While this study is among the first to use multiple measures of working conditions to explore quantitative changes in novice teachers' effectiveness, it has several limitations. One limitation is that the measure of teacher effectiveness encompasses just two of the subjects students learn in school. In reality, teachers are responsible for a greater range of academic subjects than is captured here, and may impact a variety of non-academic outcomes, such as social skills and civic engagement, as well. In addition, the outcome measures are derived from standardized state assessments; if such assessments are not adequately aligned to the curriculum these measures may be limited in the extent to which they capture meaningful differences in instructional quality. Thus, the reliance on value-added estimates as the sole measure of teacher effectiveness is clearly a limitation.

Furthermore, ideally I would analyze at least five years of data on each teacher; as noted by Singer and Willett (2003), more waves of data are always better in longitudinal data analysis. However, teachers frequently change grades taught, which reduces the number of teachers for whom we can estimate value-added scores for multiple years. Consequently, increasing the

number of waves of data comes at a cost of limiting generalizability. In an effort to broaden generalizability, I opted to focus on the changes that occur between subsequent years. This approach seems reasonable in light of the research on returns to teacher experience, which appears to occur primarily in the first few years of teaching.

Despite these limitations, this work contributes to our understanding of how teachers' working environments shape new teachers' changes in effectiveness with regard to essential aspects of the curriculum—i.e., English language arts and mathematics. Exploring changes in teachers' value-added allows each teacher to serve as his/her own control; therefore, it is less likely that the results are confounded by sorting mechanisms (e.g. the ability of schools with better working conditions to attract more effective teachers). Thus, this approach supports stronger inferences regarding the role of working conditions in contributing to teachers' effectiveness.

Another strength of this study is the use of multiple data sources on working conditions. Teachers' perceptions provide a sense of perceived reality from the individuals who experience those working conditions daily. However, because teachers experience a limited number of school settings, their frame of reference when rating their school is limited. Furthermore, teachers who respond to the survey may be a non-representative sample of teachers in the school. External reviewers have a broader frame of reference, since they visit a variety of schools. Their ratings are based on a rubric that guides the systematic evaluation of working conditions. One drawback of external reviewers' ratings is that such ratings are based on observations and interviews over the course of just a few days. Both sources of information have strengths as well

as limitations; using both data sources allows for a more thorough investigation of working conditions' role in shaping outcomes.

I find that the perceived strength of a school's learning community is a significant predictor of novice teachers' value-added in English language arts, which is consistent with Johnson, Kraft and Papay's (2012) study, in which school culture predicted school achievement growth in English language arts. Similarly, the positive relationship between collegial support and mathematics value-added is consistent with Goddard, Goddard, and Tschannen-Moran's (2007) research in elementary schools in a Midwestern school district. These findings also fit with Rosenholtz's (1989) path analysis, in which teachers in rural districts in Tennessee had greater learning opportunities when they taught in collaborative environments that stressed norms of continuous improvement.

Although both Ladd (2009) and Johnson, Kraft and Papay (2012) find school leadership to be a critical factor in schoolwide achievement gains, in the current study, teachers' perceptions of school leadership are not predictive of novice teachers' gains in value-added. However, I find that several factors based on the Quality Review are associated with these gains, and the rubric for the Quality Review constructs repeatedly refers to the role of school leaders in implementing and guiding the practices on which the school is rated. Thus, the positive relationship between Quality Review factors and novice teachers' value-added suggests that school leadership may play a role in shaping new teachers' effectiveness, especially if we consider specific practices. In particular, the leadership constructs used by Ladd (2009) and Johnson, Kraft and Papay (2012) include elements related to teachers receiving feedback, which overlaps with the capacity building construct in the current study. That is, the descriptors in the rubric for capacity building

reference feedback; compared to teachers in schools with average ratings, novice teachers' effectiveness is higher, on average, in schools with higher ratings on capacity building.

Despite limited empirical evidence of the effectiveness of data use (Hamilton et al., 2009), recent educational policies have encouraged the use of data to inform instruction and decision-making. The current study provides some empirical support for such practices. Three of the five Quality Review constructs are positively associated with improved teacher effectiveness in mathematics; one (capacity building) has a direct positive relationship with teacher effectiveness in English language arts. For English language arts, the relationship between the Quality Review constructs and novice teachers' effectiveness is positive in particular contexts: those in which teachers perceive a learning community.

As Datnow, Park and Kennedy-Lewis (2012) note, the presence of data alone does not ensure improved practice. Data may enable teachers to more carefully tailor instruction, but Datnow et al. found that in the absence of information about strategies to address gaps in student learning, some teachers did not find that data helped them improve instruction. The findings of the current study suggest that data use and strategic decision making have direct effects on mathematics, but with regard to English language arts, such practices are only useful when they occur in environments where people share information about what does and doesn't work, discuss problems, and explore new instructional approaches.

While some of the findings of the current study are consistent with work from various other researchers, other findings are not consistent with prior work. For example, although prior work suggests that teachers benefit from having higher-quality peers (Jackson & Bruegmann, 2009), I did not find a direct relationship between the value-added of veteran teachers and novice teachers' value-added. It is possible that a relationship between the value-added of veteran

teachers and novice teachers' gains in value-added exists, but takes hold over a period of years. Alternatively, this relationship may be contingent upon the extent to which veteran and novice teachers work together. Studies that use qualitative approaches or social network analysis to explore teacher interactions may be better suited to revealing whether and how collegial qualifications influence the novice teachers' effectiveness.

These findings have implications for policy and educational reform, which has expanded the focus of accountability policies to hold individual teachers as well as schools accountable for student achievement. Race to the Top awarded grant applicants points on the basis of whether teacher evaluation systems take into account data on student growth as a significant factor, and also awards points based on whether these evaluations are used to inform decisions regarding compensation, tenure, and removal of ineffective teachers.<sup>36</sup> As the Race to the Top grants are rolled out and districts begin to include measures of student growth in teachers' evaluation scores, use of value-added estimates in an effort to capture the contribution of a specific teacher to growth in student achievement is likely to become more widespread in education accountability policies.

Yet many researchers have debated about what exactly value-added estimates capture. One question regarding value-added is whether we should hold teachers responsible for student progress when many factors affecting this progress are outside the control of teachers (Lissitz, 2005). Because these results suggest that working conditions influence teacher effectiveness (as opposed to simply attracting already effective teachers), comparing the value-added scores of

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<sup>36</sup> Regarding use of evaluations to inform decisions regarding removal of ineffective teachers, it further says "after they have had ample opportunities to improve" (U.S. Department of Education, 2009a, p. 9).

teachers in different schools, who experience different working conditions, conflates the teachers' effectiveness with aspects of the school environment not within their control.

One potential solution would be to use value-added metrics that include school fixed effects for an “apples to apples” comparison of teachers within a school. However, as McCaffrey, Lockwood, Koretz, Louis, and Hamilton (2004) note, this approach can remove legitimate differences in teacher effects across schools. Furthermore, precisely because such measures do compare teachers to other teachers in their own school, they may undermine collegial support and professional learning communities. As another alternative, those considering implementation of teacher value-added models as part of a teacher evaluation system could attempt to account for variation in working conditions when devising metrics of teacher effectiveness. This approach could serve an additional purpose by helping districts identify schools with relatively poor working conditions. Working conditions could become part of the model itself, or be used as contextual information when district leaders are faced with conflicting evidence from multiple measures of teacher effectiveness.

Tracking school working conditions and evaluating their impact on teachers' effectiveness could help educational leaders more efficiently support school improvement efforts. The information generated by such analyses could be used to target resources to specific schools to enhance aspects of the school environment that are most likely to improve teacher effectiveness, such as professional learning communities, collegial support, and practices regarding data use and strategic decision-making. Such efforts would be aligned with the selection criteria of Race to the Top, which encourages the use of “data to improve instruction” and provision of “effective support to teachers and principals” (U.S. Department of Education, 2009a, p. 3). The support described in the executive summary of Race to the Top includes data-

informed professional development—much like what the capacity building construct from the New York City Quality Review captures. Efforts to develop and sustain learning communities, foster collegial support, and build capacity may foster improvements in instructional quality among the current workforce, and enable districts to support and grow the teachers they already have.

However, given the limitations of this study, further work is warranted. Well-designed research could help assess the efficacy of interventions intended to develop and enhance learning communities, collegial support, data use and strategic decision-making. Future research could also explore whether these relationships between working conditions and teacher effectiveness are cumulative, and whether the effectiveness of teachers with more experience is also influenced by working conditions. In addition, further research would be useful to assess some of the seeming contradictions uncovered in this work. For example, the findings of this study suggest that working conditions interact in complex ways to shape teacher effectiveness; looking forward, we might build on existing research on collegial support and learning communities to further explore this complexity. How can school leaders facilitate and enhance collegial support in ways that impact student achievement? How might school time be organized to foster a stronger learning community among teachers? And how are these facets of the school environment impacted by a growing focus on data? Close examination of the schools that are successful in both fostering a learning community and in using data, as well as examination of schools that are less successful, may facilitate a more thorough understanding of how schools can be improved and what practices to avoid.

## Chapter 5: Conclusions

Do teachers' working conditions influence the presence and productivity of human capital? This overarching question has guided the analyses in this dissertation. The three empirical studies presented in this dissertation explore ways in which various aspects of school working conditions, including aspects of social capital and informational resources, shape the presence and productivity of human capital in public schools. Although effect sizes are small, I find evidence that working conditions are related to the outcomes of interest. I briefly overview the results of each study, then explore the consistencies and inconsistencies across the three studies, review limitations of the studies, and explore the implications of the findings as they relate to current policies, potential practices, and theory.

### Summary

In Chapter 2, I examined ninth grade students' access to quality mathematics teachers both within and across schools. I find that within schools, higher achieving students are more likely to have quality teachers, which is consistent with previous work. However, the strength of this relationship varies across schools. Compared to low-achieving students in low-performing schools, in schools with higher average achievement, students with lower achievement are more likely to have a quality teacher. Additionally, principal support plays a role in student access to quality teachers: in schools with higher levels of perceived principal support, low-achieving students are *less* likely than their higher-achieving peers to have a quality teachers, while in schools with lower perceptions of principal support, students' prior achievement has little relationship with their odds of having a quality teacher.

Regarding school context and working conditions' relationship to student access to quality teachers more broadly, I find that students are more likely to have access to quality teachers in schools with higher average socioeconomic status and greater levels of collegial support. I did not find main effects for any other working conditions, but I find that working conditions interacted with school context. Specially, in schools with low average achievement, teachers' expectations and student problems are related to student access to quality teachers: students in low-performing schools are more likely to have a quality teacher in schools where teachers reported that their colleagues had high expectations for students, and are less likely to have a quality teacher in schools where teachers perceived a high level of student problems.

In Chapter 3, I investigate the relationship between working conditions and teacher effectiveness in elementary schools. I find that teacher effectiveness in both English language arts and mathematics is greater in schools in which teachers perceive greater collegial support and in which external reviews rate data use and strategic decision-making (from the Quality Review rubric) more highly. Here, too, I find interactions between working conditions and school poverty: instructional coherence and the extent to which schools engage in monitoring goals and revising plans are related to average teacher effectiveness in English language arts, but only in higher-poverty schools.

Chapter 4 extends the work of Chapter 3 but looks specifically at novice teachers. I find that novice teachers' gains in effectiveness in English language arts are greater in schools where teachers perceive stronger learning communities, while gains in effectiveness in mathematics are greater in schools where teachers perceive greater collegial support. The extent to which the school uses data to build capacity is related to gains in effectiveness in both subjects; Quality Review constructs of instructional coherence and planning and setting goals have main effects

for mathematics but not English language arts. I do not find interactions between working conditions and school poverty; however, I do find that the working conditions themselves interact. Specially, school data use and strategic decision-making practices are associated with greater effectiveness in English language arts in schools with strong learning communities; however, in schools with relatively weak learning communities, greater data use and strategic decision-making practices are associated with lower levels of effectiveness in English language arts.

### **Three Studies: How Working Conditions Influence the Distribution and Productivity of Human Capital**

In each study, at least one aspect of schools' working conditions was directly related to the outcome of interest. Collegial support stood out as the most consistent predictor of the outcomes explored. At the high school level, students in schools in which teachers perceive greater support from colleagues are more likely to have a quality mathematics teacher. At the elementary school level, teachers are more effective on average and novice teachers experience greater growth in effectiveness in mathematics when teachers perceive greater levels of collegial support. Schools' use of data for strategic decision-making is also a consistent predictor of outcomes across the two studies in which this construct was employed; both average teacher effectiveness and novice teachers' gains in effectiveness are related to use of data for strategic decision-making.

However, other working conditions are not related to outcomes. In some cases, this lack of relationship is consistent with prior studies. For example, I did not find professional development to be related to teacher effectiveness on average or to novice teachers' growth in effectiveness. This finding is not surprising given the mixed evidence on professional development (c.f. Garet et al. 2008, 2010). Furthermore, it is possible that additional

professional development is provided to schools as an intervention to address low student achievement. If so, the relationship between professional development and teacher effectiveness would be confounded by non-random assignment of teachers to additional professional development.

In other cases, my findings are contrary to previous studies. For example, principal support does not exhibit a significant main effect on students' odds of having a quality teacher, nor does leadership predict teacher effectiveness or novice teachers' growth in effectiveness. These findings are inconsistent with prior research that point to the importance of school leadership in terms of teacher retention and student achievement (Boyd et al., 2011; Grissom, 2011; Ladd, 2009).

The lack of a relationship between teachers' perceptions of leadership and their effectiveness may reflect issues in the measurement of the construct. That is, it may be that teachers' perceptions of leadership are not an especially strong measure of the quality of leadership. In fact, I found that external reviewers' ratings of data use and strategic decision making are related to *both* average teacher effectiveness *and* novice teachers' gains in effectiveness; these ratings reflect, in part, external reviewers' judgments regarding the quality of leadership practices. Thus, whether leadership is related to improvements in teacher effectiveness may depend on how these aspects of school working conditions are measured. Perhaps teacher perceptions reflect teacher satisfaction rather than quality; teachers may be satisfied with cordial school leadership, even if the school leaders are not particularly effective at supporting student achievement on standardized assessments.

One potential explanation for why measures based on the Quality Review are related to novice teachers' growth while teachers' own perceptions of leadership are not related to growth

is that external review measures may be a stronger signal of the elements of leadership that help teachers improve student achievement than are teacher perceptions. This hypothesis is consistent with Perrow's (1986) critique of the leadership subset of the human relations model of organizational theory. The leadership subset of the human relations model holds that good leaders improve employee morale, which leads to increased effort and greater production; thus, the human relations tradition views managerial or supervisory behavior as influencing employee cooperation and motivation. Perrow (1986) notes that "exceptional leadership" generally refers to good decisions around organizational structure and other business decisions, rather than cooperation and motivation of employees (p. 88). It may be that teacher perception measures used in this study capture the elements of leadership that are linked to cooperation or motivation, while the Quality Review factors pick up on elements of leadership that are related to a strong focus on student achievement on standardized assessments.

Although the literature indicates that a variety of working conditions influence teachers' career decisions, satisfaction, and student achievement, this study suggests that working conditions' relationship to the outcomes explored here is moderated by school context. For example, in Chapter 3 I find that instructional coherence and the extent to which schools engage in monitoring goals and revising plans have a positive relationship with average teacher effectiveness in English language arts, but only in higher-poverty schools. Thus, working conditions may be most critical in schools that have the least advantaged students and the greatest challenges for teachers.

Finally, the results of this dissertation, particularly in the third study, suggest that the relationships between working conditions and desired outcomes are complex. As noted by Rosenholtz (1989), the success of any strategy depends in large part on the social organization of

the school. In this dissertation, I find that the relationship between data use practices and novice teachers' growth in effectiveness depends on whether the school is perceived as organized to support teachers' continued learning. Higher ratings of data use and strategic decision making are associated with gains in effectiveness in schools with reportedly average and strong learning communities that encourage continuous improvement and investigation of new teaching strategies. However, in schools with reportedly weak learning communities, data use and strategic decision-making is associated with reduced effectiveness. School practices do not occur in isolation but rather interact with existing school cultures to shape the final result of such practices. Consequently, encouraging data use and strategic decision-making may not result in improved outcomes unless teachers have opportunities to try new approaches and to share ideas with colleagues.

### **Limitations**

The contribution of this dissertation is that it questions an assumption underlying many current educational reforms: that teacher distribution, effectiveness, and changes in effectiveness are determined by the individual teacher. While teacher preferences, innate talent, and motivation to improve undoubtedly influence the presence and productivity of human capital, the social organization of schools is also related to these outcomes. In other words, school policies and practices matter—they may either facilitate teacher productivity or impede teacher productivity. Yet the findings within this dissertation should be interpreted with caution. In this section, I consider several limitations of these studies that have implications for reliability and validity of the findings.

First and foremost, the data used in this dissertation are non-experimental in nature. While I am able to control for a wide variety of school and student characteristics, it is possible

that I have not accounted for all potentially confounding variables. The analyses herein lend support to the theoretical argument by indicating the strength of associations between working conditions and the various outcomes. Since teachers are not randomly assigned to schools, studies such as these, based on observational data, are the predominant means of informing educational policy decisions and may inform the design of randomized control experiments. However, large-scale longitudinal or experimental design studies would be required to make strong causal claims about the link between working conditions and human capital.

A second limitation is related to the generalizability of the results. While the first study uses a nationally representative sample, the findings are generalizable only to students enrolled in ninth grade mathematics classes. It is uncertain whether the same patterns would hold for students in different grades and subject areas. In contrast, the results of the second and third studies are generalizable to teachers of fourth and fifth grade in a large, urban, mostly low-income school district; thus the results of these studies may not generalize to teachers of students in early grades or those working in middle or high schools. A considerable amount of research has focused on students in fourth and fifth grades, in part because under No Child Left Behind students are tested in third through eighth grades on an annual basis. Not only are data available, but compared to data on middle and high school students, data on students in fourth and fifth grade are particularly attractive to researchers because these students typically have a pretest score and are more likely to have a single teacher to whom gains can be attributed. While data availability and the contained classroom structure are distinct advantages of focusing on students in fourth and fifth grade and their teachers, the trade-off is that findings pertain to upper elementary students and may not extrapolate beyond this population.

The measures I use to examine the constructs have important limitations. The various working conditions may be construed as forms of social capital (e.g. leadership, learning communities) and informational resources (professional development, data use), but all are somewhat ambiguous constructs. This ambiguity stems in part from a lack of consensus regarding what constitutes quality leadership or a quality learning community. In addition, ambiguity arises from the relatively recent advent of research around data use; theories have just been developed in the past five years (Black & Wiliam, 2009). Thus it is perhaps not surprising that while many of the various social capital and informational resource constructs have been explored in other work, the measures used to capture these constructs vary greatly.

Though informed by the existing literature, the measures I created do not correspond precisely to the measures used by others. The lack of clear definitions and consistent measures of these constructs makes it difficult to synthesize findings from across studies and limits the potential for this literature to inform research, policy, and practice. Future research that focuses on conceptual development and empirically investigates these constructs has the potential to advance our understanding of which aspects of working conditions influence the quality of human capital in schools.

Finally, in considering the influence of school working conditions, I examined only three possible outcomes: student access to quality teachers, average teacher effectiveness in schools, and gains in novice teachers' effectiveness. For Chapter 2, the conceptualization of a quality high school mathematics teachers was based on research that linked teacher characteristics and qualifications to teachers' impact on student achievement as measured by standardized tests. In Chapters 3 and 4, the outcome measures are intended to capture teachers' impact on student achievement in core subject areas. Thus, for all outcomes, the outcome measure is intended to

be related (directly or indirectly) to student achievement. However, if the tests used to generate the estimates of value-added are unaligned to curriculum, these outcomes may fail to capture important differences between teachers in their ability to implement the curriculum effectively.

Furthermore, even if the measures perfectly capture teachers' ability to implement English language arts and mathematics curriculum effectively, improved student achievement in these core subject areas is just one of many important goals of schools. Schools serve many purposes beyond providing numeracy and literacy, such as promoting civic knowledge and participation, developing emotional intelligence, and fostering teamwork. Prior research indicates that teachers influence students' social and emotional growth as well as gains in academic achievement (Jennings & Diprete, 2010). Since the development of students' non-cognitive skills has important implications at both the individual and societal levels, it would be valuable to explore how working conditions are associated with outcomes other than those pertaining to academic performance.

### **Implications for Policy, Practice, and Research**

As noted in the introduction of this dissertation, public schools in the United States are increasingly being held accountable for students' performance on standardized assessments in core academic subject areas. In fact, public school *teachers* are increasingly being held accountable for student performance under policies such as the Teacher Incentive Fund and the Race to the Top initiative. Many current education reform efforts are targeted at improving human capital in schools. Efforts to improve a school's human capital fall into two distinct categories: approaches that emphasize recruitment, retention, and selective removal of educators, and approaches that attempt to improve the effectiveness of the current educator workforce, such as professional development (Jerald, 2012). This dissertation explores whether and to what

extent teachers' working conditions might improve the distribution and productivity of human capital in schools, and thus has implications for the current accountability regime and education reform efforts.

Recognizing the inequitable distribution of teachers across schools, policymakers have sought ways to attract and retain teachers in high-needs schools. For example, one of the stated goals of the Teacher Incentive Fund is to increase the number of effective teachers teaching poor, minority, and disadvantaged students in hard-to-staff subjects (Office of Elementary and Secondary Education, 2006). Yet several recent studies of education pay incentives have yielded disappointing or inconsistent results regarding the impact on retention of teachers (Glazerman & Seifullah, 2012; Malen et al., 2011; Marsh et al., 2011). Financial incentives alone may be insufficient to retain teachers. In explaining why financial incentives were not a strong factor in their decisions to remain at a particular school, many teachers pointed to aspects of school working conditions, such as strong ties to colleagues and administrators, as more salient to their decisions (Malen et al., 2011).

The results in this dissertation suggest that students in schools in which teachers support one another have greater access to quality teachers. Future research might explore what types of teacher support are most critical, whether support from colleagues matters more for early career teachers, and the extent to which this finding holds among teachers of other grades and subject areas. In addition, I find that in low-achieving schools, student access to quality teachers is related to several other working conditions. Future research could explore the approaches low-achieving schools use to sustain a culture of high expectations and to minimize student problems and whether these efforts influence retention of quality teachers. Finally, future studies could explore the implications of differences in within-school sorting, because little is known about the

costs and benefits of such sorting and how these costs and benefits affect different types of students. For example, researchers might investigate whether allocating quality teachers to low-achieving students helps these students to catch up to their peers, and whether and to what extent access to quality teachers impacts higher-achieving students.

The second and third studies that make up this dissertation suggest that collegial support and data use influence teacher effectiveness and how much new elementary school teachers improve as they gain experience. These results, as well as other recent studies (Hansen, 2013; Taylor & Tyler, 2011), support the notion that important education outcomes are, to some extent, influenced by school norms and practices. However, we know little about *how* these norms and practices lead to better outcomes. For example, do teachers in schools that make use of the data available as an informational resource differentiate instruction more often? Are they more likely to identify and replicate effective practices, or avoid ineffective practices? Do they strategically re-teach concepts as needed? Additional research could shed light on how schools might use data to improve their teaching strategies and foster learner-centered instruction.

Information on student progress will only be useful if “teachers know how to use data to identify students’ misconceptions, link those misconceptions to the curriculum, and design instruction that promotes desirable forms of learning” (Valli, Croninger, Chambliss, Graeber & Buese, 2008, p. 165). Districts and school leaders can help teachers by providing professional development that shows teachers how to interpret data and provides ideas on how to develop instructional responses to the data (Valli et al., 2008). While much of current educational policy focuses on individual teachers, the findings of this study suggest that data-informed common planning and collaboration time is a promising strategy. On the other hand, too much focus on standardized assessments may be demoralizing to teachers and ultimately diminish the quality of

instruction, such as when teachers focus on decontextualized test preparation (Valli, Croninger, Chambliss, Graeber, & Buese, 2008). It is important for future research to explore not just the promising practices in data-informed common planning, but also how and why such a focus on data can lead to unintended outcomes.

Focusing on ways to enhance collegial support and collaboration as well as use of data may improve students' chances of having a quality as well as effective teacher. However, the findings in this dissertation suggest that the relationships between school working conditions and desired outcomes are complex and are moderated by the interplay between various working conditions. The efficacy of efforts to improve educational outcomes by fostering collegial support and data use is likely to vary as a function of differences in schools' culture and norms, particularly the extent to which teachers embrace continuous learning. Unfortunately, while we have known for some time that some schools have more positive forms of social organization than others (Rosenholtz, 1989), it is less clear how school districts or school leaders can systematically generate more desirable forms of social organization. While some districts have made efforts to foster professional communities, these efforts do not always translate into improved instruction and student learning (Supovitz, 2002). In part this issue is related to the conceptual ambiguity around the constructs explored. Developing a clear definition of what constitutes a "learning community" and establishing better measures of constructs like "collegial support" would facilitate future work in this area.

Another avenue for future work is integrating working conditions into program evaluation. To the extent that the presence and productivity of human capital are contingent on organizational and workplace factors, such factors may either enhance or diminish policy investments in human capital. Attention to working conditions as part of the description of the

setting in future program evaluations might illuminate the contradictory or mixed results that policy research often yields. Failure to account for variation in working conditions may obscure the impact of policies and programs targeted at enhancing human capital. Furthermore, additional research could enhance knowledge of the factors that enhance or diminish the efficacy of such efforts. Such research could support the efforts of education leaders in developing and implementing initiatives in ways that are more likely to be successful.

The conversation around educational reform efforts and initiatives like Race to the Top tends to focus on the accountability aspect; discussions have included a focus on legitimate concerns over how teacher effectiveness will be measured and whether it is fair to remove teachers based on the evaluation systems being put in place. However, little attention has been paid to whether the structure of schools is conducive to educators' collective learning, despite the fact that Race to the Top awards grant applicants up to 20 points for "providing effective support to teachers and principals" including "data-informed professional development, coaching, induction, and common planning and collaboration time to teachers and principals" (p. 10). The current focus on accountability for results does not preclude efforts to improve teaching by fostering the development of social capital through organizational policies and practices. Given the sheer number of teachers in this country, investing in the quality of the current workforce and their workplace would seem a critical aspect of any strategy to improve human capital in the education sector.

## Appendix A: Working Conditions Across the Three Studies

Table A.1 Working Conditions Across the Three Studies

Chapter 2: Access to Quality Teachers	Chapter 3: Teacher Effectiveness	Chapter 4: Novice Teachers
Principal support	Proportion veteran	Proportion veteran
Resources & facilities	Proportion novice	Proportion novice
Expectations		Average effectiveness of veteran teachers
Collective responsibility	Leadership	Leadership
Collegial support	Collegial support	Collegial support
Collegial sharing	Professional development	Professional development
Planning time		Learning community
Autonomy	Quality Review	Quality Review
Student problems		
School climate		

## Appendix B: Items in NYC School Survey and Quality Review

Table B.1 Factor Scores from New York City School Survey Data

Factor	Items	Alpha
Leadership	School leaders communicate a clear vision for this school.	Y1: 0.960
	School leaders let staff know what is expected of them.	Y2: 0.959
	School leaders encourage open communication on important school issues.	Y3: 0.962
	Curriculum, instruction, and assessment are aligned within and across the grade levels at this school.	
	The principal places the learning needs of children ahead of other interests	
	The principal is an effective manager who makes the school run smoothly.	
	I trust the principal at his or her word.	
	The principal has confidence in the expertise of the teachers.	
	School leaders invite teachers to play a meaningful role in setting goals and making important decisions for this school.	
	School leaders encourage collaboration among teachers.	
	School leaders visit classrooms to observe the quality of teaching at this school.	
	School leaders give me regular and helpful feedback about my teaching.	
	School leaders place a high priority on the quality of teaching at this school.	
School leaders celebrate learning successes at this school. (To what extent do you feel supported by) your principal?		
Professional Development	The professional development I received this year provided me with teaching strategies to better meet the needs of my students.	Y1: 0.902
	This year, I received helpful training on the use of student achievement data to improve teaching and learning.	Y2: 0.902
	The professional development I received this year provided me with content support in my subject area.	Y3: 0.893

Table B.1 Factor Scores from New York City School Survey Data (Continued)

Factor	Items	Alpha
Collegial support	Teachers in my school respect teachers who take the lead in school improvement efforts.	Y1: 0.882
	Teachers in my school trust each other.	Y2: 0.879
	Teachers in my school recognize and respect colleagues who are the most effective teachers.	Y3: 0.882
	Most teachers in my school work together on teams to improve their instructional practice.	
	(To what extent do you feel supported by) other teachers at your school?	
	Teachers in this school respect teachers who take the lead in school improvement efforts.	
Learning Community	In this school, it's easy to speak up about what is on your mind	Y2: 0.989
	People in this school are eager to share information about what does and doesn't work	Y3: 0.944
	People in this school are usually comfortable talking about problems and disagreements	
	This school frequently explores new ways of working.	
	This school has a formal process for trying out and evaluating new ideas.	
	This school frequently tries out new instructional practices or strategies.	
	Our school is focused on improving performance on measures of student achievement for this year.	
	Meeting targets for student progress is a priority in this school.	
	Helping students reach targets for mastery of important skills and content is a priority for this school.	

Table B.2 Factor Scores from New York City Quality Review

Factor	Items	Alpha
Instructional and organizational coherence	<p>Design engaging, rigorous and coherent curricula</p> <p>Develop teacher pedagogy from a coherent set of beliefs about how students learn best</p> <p>Make strategic organizational decisions to support the school’s instructional goals and meet student learning needs evidenced by meaningful student work products</p> <p>Maintain a culture of mutual trust and positive attitudes toward learning that support the academic and personal growth of students and adults</p>	0.821
Gather and analyze data	<p>Gather and analyze information on student learning outcomes to identify trends, strengths, and areas of need at the school level</p> <p>Align assessments to curriculum, use on-going assessment practices, and analyze information on student learning outcomes to adjust instructional decisions</p> <p>Use grading policies and tools to enable school leaders and teachers to organize, aggregate, and analyze student performance trends</p> <p>Engage families in school decision-making, activities, and an open exchange of information regarding students’ progress</p>	0.818
Plan and set goals	<p>Establish a coherent vision of future development that is reflected in a short list of focused, data-based goals</p> <p>Use collaborative and data informed processes to set measurable and differentiated learning goals for student subgroups</p> <p>Ensure the achievement of learning goals by tracking progress at the school, teacher team and classroom level</p> <p>Communicate high expectations to staff, students and families</p>	0.789
Capacity building	<p>Use the observation of classroom teaching and the analysis of learning outcomes to elevate school-wide instructional practices and implement strategies that promote professional growth and reflection</p> <p>Engage in structured professional collaborations on teams using an inquiry approach that promotes shared leadership and focuses on improved student learning</p> <p>Provide professional development that promotes independent and shared reflection, opportunities for leadership growth, and enables teachers to continuously evaluate and revise their classroom practices to improve learning outcomes</p> <p>Integrate child/youth development, guidance/advisement support services and partnerships with families and outside organizations with the school-wide goals t</p>	0.847

Table B.2 Factor Scores from New York City Quality Review (Continued)

Factor	Items	Alpha
Monitor and revise	<p>Evaluate the quality of curricular, instructional, and organizational decisions, making adjustments as needed</p> <p>Evaluate systems for assessing students, organizing data, and sharing information with students and families, making adjustments as needed</p> <p>Establish and sustain a transparent, collaborative system for measuring progress toward interim and long term goals and making adjustments</p> <p>Use data to regularly evaluate the effectiveness of structured professional collaboration, capacity building and leadership development strategies</p>	0.888

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