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Abstract

Purpose: This study examines the influence of principal leadership in high schools on classroom instruction and student achievement through key organizational factors, including professional capacity, parent–community ties, and the school’s learning climate. It identifies paths through which leadership explains differences in achievement and instruction between schools and differences in instruction among teachers within the same school. **Research Design:** Multilevel structural equation modeling was used to examine the relationships among principal leadership, school organizational structures, classroom instruction, and student grades and test gains on ACT’s Education Planning and Assessment System. Measures of principal leadership and school organizational structures were collected from teacher surveys administered to all high school teachers in Chicago Public Schools in the 2006–2007 school years. **Findings:** Within schools, variation in classroom instruction is associated with principal leadership through multiple pathways, the strongest of which is the quality of professional development and coherence of programs.

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Between schools, differences in instruction and student achievement are associated with principal leadership only via the learning climate. This suggests that in high schools, establishing a safe, college-focused climate may be the most important leadership function for promoting achievement schoolwide.

Keywords

principal leadership, school organizational factors, classroom instruction, student learning, multilevel SEM, survey research

Principal leadership is viewed as a key mechanism for improving schools. The U.S. Department of Education's recent efforts to radically transform the nation's worst 5,000 schools includes replacing principals of failing schools as one of its central strategies (Abrevaya & White, 2009). According to U.S. education secretary Arne Duncan, "There's no such thing as a high-performing school without a great principal. . . . You simply can't overstate their importance in driving student achievement, in attracting and retaining great talent to the school" (Connelly, 2010, p. 34). Research on principal leadership seems to support the importance of the principal in guiding school reform and improving student achievement. Leithwood, Louis, Anderson, and Wahlstrom (2004) reviewed both quantitative and qualitative research on school leadership and concluded that leadership is second only to classroom instruction among school-related factors in influencing student learning. Research also suggests that these effects are largely indirect, operating through school organizational features (see, e.g., Hallinger, Bickman, & Davis, 1996; Hallinger & Heck, 1996, 1998; Witziers, Bosker, & Kruger, 2003).¹ However, as discussed below, there are substantial gaps in our knowledge of how leaders are most effective. Previous studies have been unable to examine the myriad mechanisms through which principals may affect classroom instruction and student achievement.

Furthermore, research is limited at the high school level. Most research on leadership that connects school leadership to student learning is based in elementary schools. We would expect leadership to matter at the high school level as well, although the mechanisms through which leaders are most effective may differ. High schools are typically larger, more departmentalized, and more organizationally complex. Principals may find it more difficult to work directly with teachers in high schools, given the size of the school, their own subject matter expertise, and differentiation among staff roles.

This study addresses these gaps in existing research by asking in what ways leadership in high schools is related to instruction and learning, which mechanisms seem to be the most important for instructional improvement, and whether school leaders have differential effects among individual teachers within their school versus the faculty as a whole. We base this study in Chicago Public Schools (CPS), using teacher survey data and student administrative data. One limitation is that we do not know to what extent the findings of this study can be generalized to other locations, especially nonurban settings.

The Complex Role of High School Leaders

Principals are expected to carry out a wide range of functions, and research is not clear on which roles and responsibilities are most important for principals to improve instruction and learning. Isolating the most important leadership practices across various studies is challenging, although three leadership practices are commonly referenced: (a) focusing the mission and goals of the school, (b) supporting trust and collaboration in the building, and (c) actively supporting instruction (Hallinger, 2005; Supovitz, Sirinides, & May, 2010). These roles, conceptualized as instructional leadership, have been the focus of much of past research on principals (Hallinger, 2005; Hallinger & Heck, 1996). One perspective of instructional leadership suggests that principals need to have expertise in subject-specific content and pedagogy (Stein & D'Amico, 2000; Stein & Nelson, 2003). Other perspectives focus on the role of the principals in supporting generally good instruction practices in schools (Hallinger, 2005; Halverson, Grigg, Prichett, & Thomas, 2007; Louis, Dretzke, & Wahlstrom, 2010). This may depend on the complexity of the school; it may be difficult for principals to provide content expertise in secondary schools where they may not have great familiarity with the content and curriculum of multiple disciplines (Louis, Dretzke, et al., 2010).

Strong leadership *practices* are intended to affect school *processes* that mediate the effects of leadership on student achievement. Studies on leadership have pointed to a wide array of school processes through which leadership can influence student learning. Those processes can be broadly classified into four areas, following Bryk, Sebring, Allensworth, Luppescu, and Easton (2010) in their framework of essential supports—the professional capacity of staff, the learning climate of the school, family and community involvement, and ambitious instruction. Bryk et al. found that big differences in test score gains occurred among elementary schools that were strong on multiple dimensions. Thus, school leaders might be expected to develop school capacity in each of these four areas to improve student achievement.

In the framework of essential supports, the professional capacity of the staff includes the “combination of skills, beliefs, dispositions, and work arrangements of teachers at the school” (Bryk et al., 2010, p. 54). One key aspect of this dimension is professional community—the degree to which teacher interaction is frequent and actions of teachers are governed by shared norms focused on teaching and learning (Bryk, Camburn, & Louis, 1999; Kruse, Louis, & Bryk, 1995). There is accumulating evidence that schools where such structures exist make improvements in instruction and learning (V. E. Lee & Smith, 1996; Lomos, Hofman, & Bosker, 2011; Louis & Marks, 1998) and that principal leadership has a strong influence on the school’s professional community (Bryk et al., 1999; Youngs & King, 2002).

Another important process through which principals influence the professional capacity is structuring effective professional development programs (Newmann, King, & Youngs, 2000). Research has shown that effective professional development concentrates on instruction and student learning outcomes, promotes collaboration among peers, provides opportunities for reflection, feedback, and critical thinking, and is sustained and continuous (Corcoran & Goertz, 1995; Little, 2003; Smylie, Allensworth, Greenberg, Rodney, & Luppescu, 2001). Furthermore, opportunities for professional development need to be part of an overall coherent program of teacher learning (Garet, Porter, Desimone, Birman, & Yoon, 2001; Newmann et al., 2000; Newmann, Smith, Allensworth, & Bryk, 2001; Penuel, Fishman, Yamaguchi, & Gallagher, 2007). Program coherence, the degree to which all programs in the school are guided by a common and coherent framework of teacher and student learning, is critical for professional development to be effective. Principals play a key role in developing and sustaining effective professional development and in ensuring coherence among various programs (Youngs & King, 2002).

A second essential support, the involvement of parents and the community in children’s schooling, is well established as important for student’s academic and social development (El Nokali, Bachman, & Votruba-Drzal, 2010; Fan & Chen, 1999; J.-S. Lee & Bowen, 2006; Muller, 1993). Bryk et al. (2010) identify three practices that constitute this aspect of school capacity: reaching out and involving parents, teacher efforts to learn about their student and local community, and strengthening the network of community partnerships. Parent and community ties are a “significant resource for diverse school improvement initiatives, from enhancing safety in and around schools, to addressing problems of absenteeism and tardiness, to assuring more consistent and effective homework sessions” (Bryk et al., 2010, p. 58).

The learning climate of the school refers to the beliefs, values, and everyday interactions among school personnel, parents, and students (Bryk et al.,

2010). This includes basic needs such as the order and safety at the school, which can have strong effects on the motivation and learning of both teachers and students (Cornell & Mayer, 2010; Ripski & Gregory, 2009). Building on these fundamental needs, teachers in schools with positive learning climates hold students to high expectations, pressing them to engage in academic work with depth and rigor (Johnson, Livingston, Schwartz, & Slate, 2000).

Ultimately, it is the quality of instruction that students receive in classrooms that matters for their learning. Studies examining the effects of principal leadership on student learning assume that classroom instruction is a critical mediating factor. Principals may affect it directly, by working with teachers in classrooms, or indirectly, through their efforts to improve professional capacity, parent involvement, or school climate.

Thus, principals may attempt to improve student achievement through multiple processes, each of which has many different dimensions. The complexity of their roles may lead them to focus their efforts more on some aspects of school organization than others. Their choices about how to divide their efforts may, in turn, lead them to be more or less effective in improving instruction and student achievement. Therefore, we ask,

- Which areas of principals' work are most strongly related to classroom instruction and student achievement?
- To what extent does principal leadership explain differences in student achievement and classroom instruction across schools, and through which processes can we discern a relationship?

The Scope of Principal Leadership

The role of principal leadership is further complicated by how principals distribute their efforts across the school. Especially at the high school level, the focus of any activity may differ across teachers, grades, departments, and programs within the same school. The *scope* of principal leadership distinguishes how principals use targeted approaches on a few teachers to influence instruction and learning versus broad approaches to influence the entire faculty (May & Supovitz, 2011). Principals typically use a combination of broad and targeted approaches in their schools (May & Supovitz, 2011). The scope of principal leadership may depend on the area of the principal's own expertise, the strength of departments within the schools and supports within the schools, and other contextual factors such as school size and grade level. Furthermore, the prevalence and effectiveness of targeted approaches vary widely from one principal to the next. Especially at the high school level,

principals may be highly effective with a subset of teachers, but these effects could be small when averaged out to the entire school (May & Supovitz, 2011). Therefore, the effects of school leaders may depend not only on which aspects of their job they choose to focus but also on how they distribute their efforts across teachers in the school. This leads to a further question:

- Which processes are most effective for targeted versus whole-school efforts, in terms of principals' effects on instruction? Are there different mediating processes through which leadership is associated with instructional differences among classrooms within schools than between schools?

Studies on Leadership Have Been Limited by Data Limitations and Methodological Constraints

One of the challenges in studying principal leadership is that there are multiple mediating processes through which leaders could influence instruction and learning. Structural equation modeling (SEM) is particularly suited to examining the strength of direct and indirect relationships through multiple mediating factors simultaneously (Hallinger et al., 1996; Supovitz et al., 2010). Data used in studies of principal leadership are often multilevel, with students and teachers nested within schools. Only more recently have studies on leadership accounted for these artifacts using methods such as multilevel SEM to estimate the effects of multiple indirect pathways from leadership to instruction and learning (see, e.g., Hallinger & Heck, 2010a, 2010b; Heck & Hallinger, 2009; Louis, Dretzke, et al., 2010; Supovitz et al., 2010).

However, most studies of leadership focus on a limited set of processes making comparisons across studies difficult. The mediating influence of teacher interactions through a schoolwide professional community has been the focus of some studies (Louis, Dretzke, et al., 2010; Louis, Leithwood, Wahlstrom, & Anderson, 2010). Supovitz et al. (2010) used multilevel SEM to examine peer teacher influence as a mediating factor in the relationship between leadership and student achievement. In the framework of essential supports described by Bryk et al. (2010), these aspects fall under the professional capacity dimension. The other dimension of professional capacity, professional development of teachers, as well as the other essential supports—parent–community ties and the learning climate of the school—are

relatively less well studied using SEM and multilevel modeling.² The limitation of this set of studies that focus on a few processes is that it can lead to errors associated with omitting important variables.

On the other hand, a few studies have used broad measures of overall school capacity that combine multiple components of school capacity. Hallinger and Heck (2010a, 2010b) and Heck and Hallinger (2009), for example, used a measure of school capacity that combines seven dimensions—emphasis and implementation of standards, focused and sustained action on improvement, quality of student support, professional capacity of the school, school communication, stakeholder investment, and student safety. The limitation of this second approach is that it does not show which specific elements of school capacity are most important for classroom instruction and student learning.

In addition, few studies have included direct measures of instruction. Classroom instruction is a complex process, and existing research is not in agreement on how best to measure, define, or model it (Camburn & Won Han, 2011; Cohen & Ball, 1999; Raudenbush, 2008; Rowan, Correnti, & Miller, 2002). This is especially true at the high school level, where students take many different courses with different teachers. One needs to refer to only some of the commonly used protocols for observing classroom instruction such as the Framework for Teaching (Danielson, 1996) or the Classroom Assessment Scoring System (Pianta, La Paro, & Hamre, 2008) to understand that a wide range of factors are considered important to classroom instruction. Although researchers acknowledge the central role of classroom instruction in influencing student learning, there is limited work and little consensus on how to incorporate instruction into studies of leadership. Hallinger and Heck (2010a, 2010b) acknowledged the importance of classroom instruction but did not incorporate measures of classroom instruction. Supovitz et al. (2010) used teacher self-reports of changes in their instruction. Louis, Dretzke, et al. (2010) used a measure of focused instruction that incorporated pacing, classroom disruptions, classroom work, and opportunities for students to take charge of their own learning.

In this study we address some of the limitations in prior research through access to rich data on high schools and classrooms. The strengths of this study are that it (a) examines multiple mediating processes simultaneously while keeping them distinct from each other, (b) examines the role of leadership at the high school level, which has not been well studied, (c) differentiates the scope of work between whole-school and within-school components, and (d) incorporates direct measures of instruction into models of leadership effects on student achievement.

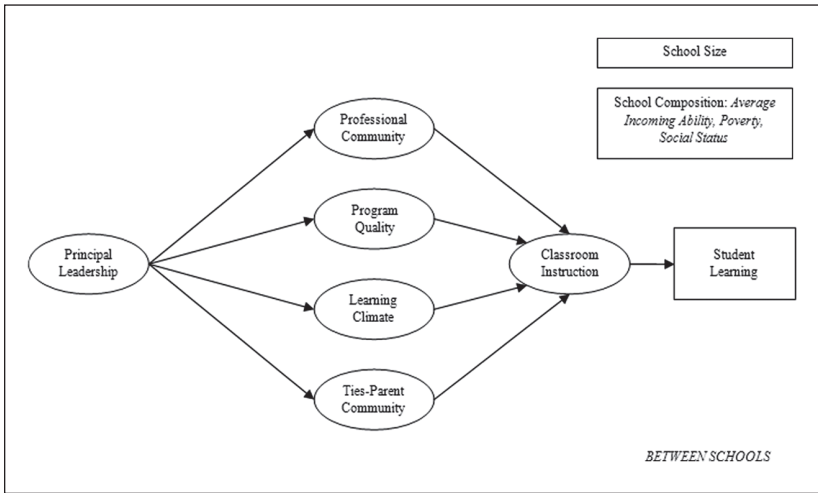


Figure 1. Between-school model of principal leadership, school organizational factors, classroom instruction, and student learning

Note. All school organizational factors are correlated with each other. All latent variables are regressed on school-level controls: school size and school context. There are two outcomes for student learning, GPA and test score gains. These outcomes are allowed to be correlated.

Conceptual Framework for This Study

We use the framework of essential supports (Bryk et al., 2010) to study a relatively comprehensive set of practices and conditions that can function as mediating variables in the relationship between leadership and student learning.

[The] framework of organizational supports for student learning starts with leadership as the driver for change. School leaders focus on four domains of work. They reach out to parents and community to connect the schools to the children, families, and communities that they serve. Simultaneously they work to enhance the professional capacity of the school through a deliberate focus on staff quality, strengthening faculty learning and teachers’ capacity to work together to align the curriculum and strengthen overall instruction. Central to making this work for children is a overall normative environment where children feel safe and are pressed and supported to engage with intellectual activity. (p. 64)

Figure 1 shows a diagram describing the relationships among leadership, mediating factors, instruction, and student learning.

Although roles of school leaders have been described broadly, we use three practices commonly identified in research on leadership to measure principal leadership, which include (a) focusing the mission and goals of the school, (b) supporting trust and collaboration in the building, and (c) actively supporting instruction (Supovitz et al., 2010). These correspond to those measures used by Bryk et al. (2010) to define leadership in their study, under the labels of instructional leadership—which encompasses both focusing the goals of the school and supporting instruction—and teacher–principal trust. Bryk et al. include program coherence as part of their definition of leadership, but here we consider this as a mediating factor through which principals develop the professional capacity of staff and influence instruction and learning. By limiting the definition of leadership in this way, we make principal activities distinct from the mediating processes through which principals may affect classroom instruction. To maintain conceptual clarity, we limit our conception of leadership to the principal. This is a limitation of this study; by focusing on only principal leadership, we are not including other important forms of leadership such as distributed and shared leadership (Camburn, Rowan, & Taylor, 2003; Heck & Hallinger, 2009; Spillane, 2006; Spillane, Camburn, & Pareja, 2007; Spillane, Halverson, & Diamond, 2004).

In addition to the internal organizational supports, the context of the school plays an important role in influencing the roles, processes, and scope of principal leadership. They both constrain and enable the work of a principal (Hallinger et al., 1996). A number of school-level contextual variables have been identified as influencing the school organization, classroom instruction, and student achievement. These include the socioeconomic characteristics of students in the school, the average incoming ability of students in the school, and the size of the school (Hallinger & Heck, 1998; Leithwood et al., 2004).

Research Method: Data

The data used for this study come from high schools that are part of CPS, the third largest school system in the United States. The student population is about 50% African American, 38% Latino, 9% White, and 3% Asian. Approximately 85% of students are eligible for free or reduced-price lunches. About two thirds of Chicago high school students remain in school to graduate. Table 1 presents the demographic and student performance characteristics for all CPS high schools and the high schools used in this study.

This study used two data sources, administrative and test data from CPS and teacher survey data. The teacher survey data come from the biennial survey administered in the spring semester of the 2006–2007 academic year

Table 1. Performance and Demographic Characteristics of Schools

Characteristic	2006–2007	
	Schools in Sample	All CPS Schools
(N, schools)	99	110
Average enrollment	1,020	974
Achievement: ACT composite score	16.64	16.80
Racial composition (%)		
African American	62.46	60.35
Latino	27.33	29.34
White	5.75	5.80
Truancy rate	9.66	9.63
Graduation rate	66.89	68.25
Attendance rate	85.26	85.76
Students—% low income	84.00	83.45
Mobility rate	22.30	21.71

by the Consortium on Chicago School Research (CCSR). The teacher surveys collected information on a range of issues including classroom instruction, professional development, learning climates, parent involvement, and principal leadership. We focus on teacher perceptions of principal leadership as well as their perceptions of school organizational structures and classroom instruction. The overall response rate for the 2007 teacher surveys was 71.6%. Data for a total of 3,529 teachers from 99 high schools were used in this study.

Measures of student achievement. Two measures of student achievement were considered for this study, unweighted student grades and gains on the Education Planning and Assessment System (EPAS). The EPAS comprises the EXPLORE, PLAN, and ACT tests. They are designed to measure student academic development over time. In 2007, all CPS 9th graders took the EXPLORE in the fall, all 10th graders took the PLAN in the fall, and all 11th graders took the PLAN test in fall and the ACT in the spring. The tests are all scored on approximately the same scale and get more difficult moving from EXPLORE, to PLAN, to ACT. To distinguish between the two PLAN tests in different grades, we refer to the PLAN test taken in 10th grade as PLAN-10 and the PLAN test taken in 11th grade as PLAN-11. We combined the outcomes of three groups of students, controlling for their score on the prior test: 9th graders on their PLAN-10, 10th graders on their PLAN-11, and 11th graders on their ACT. Because these tests are not equivalent, despite using

the same scale, we ran models that predicted each gain with dummy variables representing each scale score on the prior test with an indicator of which test it was (e.g., EXPLORE score 13, EXPLORE score 14, PLAN score 14, etc.). This allows for nonlinear relationships between the prior test and the outcome tests that are not test specific. We also included an array of student background characteristics such as race, gender, age, poverty, and socioeconomic status in the models.

The survey records do not include teacher identifiers. Therefore, we could include only student achievement information at the between-school level, comparing the performance of one school to another. For this we created school-level estimates of overall student performance that were adjusted for differences in student background characteristics, including prior ability levels.³ We used hierarchical linear models (HLMs; Raudenbush & Bryk, 2002) to obtain school-specific estimates for the average expected gain score on the EPAS after controlling for student background characteristics (grade level, age, race, gender, SES). Similarly, using the unweighted grade point average (GPA) of all students as an outcome and controlling for their background characteristics (incoming EXPLORE scores, grade level, age, race, gender, SES), we obtained school-specific estimates for the average GPA. These two school-level variables, school average test gains and school average GPA, were used as the dependent variables in the study. The details of the HLM models used to obtain these school estimates are given in Appendix A.

Measures of principal leadership and school organizational processes. The survey data provided 2 measures of principal leadership and 10 measures of school organizational factors. These composite measures were developed based on previous empirical work (Bryk et al., 2010), and scales were created using Rasch analysis (Wright & Masters, 1982). Appendix B provides a summary of the measures. The specific survey items that compose the measures are also provided in Appendix B.

Principal instructional leadership measures teachers' perceptions of their principal as an instructional leader and includes questions about whether the principal sets high standards for teaching and learning, knows what is going on in the classroom, and has clear expectations for meeting instructional goals. *Teacher-principal trust* measures the extent to which teachers feel their principal respects them and has established trusting relations with them.

Professional capacity is modeled through seven measures that fall into two sets. One set of measures describes the quality and coordination of programs in the school that support instruction: *program coherence* and the *quality of professional development*. A second set of measures describes the degree to which teachers work well together as a professional community in the school

through *reflective dialogue*, *orientation to innovation*, *socialization of new teachers*, *peer collaboration*, and *collective responsibility* (see Appendix B for details).

Two measures are used to capture the learning climate present in the school. *Teachers' perceptions of crime and disorder* is highly correlated with students' perceptions of school safety and captures problematic aspects of the environment (Steinberg, Allensworth, & Johnson, 2011). *School orientation toward postsecondary education* captures the academic environment—the degree to which the school is pressing students to have high academic achievement. A single measure represents the quality of parental and community ties: *parent–teacher interactions*.

Classroom instruction. Classroom instruction is widely acknowledged to be a complex process, but there are particular aspects that have been shown to affect student learning and that we use to define instructional quality in this study.

One important aspect of classroom instruction is simply the level of order and lack of interruptions to teaching and learning. No matter how carefully teachers plan their instruction, frequent disruptions arising from student misbehavior or other events can easily hamper potential learning. A meta-analysis by Marzano (2003) showed that classes with effective management techniques have achievement levels that are 0.521 standard deviations higher than classes without effective management techniques. A related concept is the quality of student participation. Researchers agree that student participation is critical regardless of subject or content area (Newmann & Associates, 1996; Turner & Patrick, 2004). At a basic level, students show up for class appropriately prepared with supplies, textbooks, and completing their homework. At a higher level, they actively participate in the class. Thus, we include measures of *student participation* and *classroom disruptions* as two key indicators of instructional quality.

Discussion among peers and with their teachers is a primary mode of students' participation in classrooms. At a minimum, this is marked by civil and respectful interactions, whereas higher quality discussions are characterized by engagement with content matter and the application of critical-thinking skills. Gamoran et al. (1995) found student participation and student discussion to be positively associated with student achievement. Literacy performance of both high- and low-achieving students has been shown to improve from instruction that involves discussion-based approaches (Applebee, Langer, Nystrand, & Gamoran, 2003). Our measure, *quality of student discussion*, indicates the degree to which students built on each other's ideas and provided constructive feedback during discussions.

Finally, there is considerable evidence that shows that students' higher order thinking skills are associated with their achievement (Stigler & Hiebert, 1999; Wenglinsky, 2000, 2004). *Critical thinking in assignments* measures the degree to which teachers required target-class students to employ advanced thinking skills in their written assignments. Research has shown that emphasis on analytical writing skills is associated with increased student achievement (Carbonaro & Gamoran, 2002; Langer, 2001).

The survey questions that were used to construct the measures of instruction came from a section that asked the responding teacher to provide extensive information about one specific (target) class, their second period class on Mondays. Because the surveys were administered in the spring, teachers had considerable experience with their target classes to draw some general and valid conclusions about them. See Appendix B for a list of the items that were used to make each of the measures.

Control variables. The analytical (SEM) models included school-level contextual variables—school size, average prior ability of the students in the school, average social status in the students' census blocks, and the school average of concentration of poverty in the students' census blocks. The socio-economic indicators and prior ability were highly correlated and were combined to form one composite measure.

Analytic Model

Multilevel structural equation models were specified to investigate the relationships among principal leadership, school organizational factors, instruction, and student achievement. The multilevel model takes into account the clustering of teachers (Level 1) within schools (Level 2). By specifying two levels, variations in the latent variables are partitioned between and within schools. CCSR teacher surveys do not include identifiers that allow us to link teachers' responses to specific students; thus, we cannot compare students' performance across the different types of classrooms, only by differences across schools. For this reason, the two student learning outcomes are specified only at the between-school level, whereas the variation of all other latent variables is partitioned into a within-school component and a between-school component. The relationship between the latent variables can be specified to be different at each level, which allows for the possibility that the relationships among principal leadership, organizational factors, and instruction within schools are not the same as the relationships between schools. The mediating variables are allowed to correlate with each other.

The models were analyzed using the software Mplus 5.1 (Muthén & Muthén, 2007). The estimation used maximum likelihood with robust standard errors. The EM optimization algorithm was used together with numerical integration to obtain the sample statistics for model estimation. The final model was developed in a series of steps. First, the model described in Figure 1 was specified at both levels. Instructional leadership and teacher–principal trust were made to load on a second-order factor—principal leadership. Collective responsibility, reflective dialogue, innovation, teacher socialization, and peer collaboration were specified to load onto the second-order factor—professional community. Program coherence and quality of professional development loaded onto the factor program quality. Critical thinking in assignments, quality of student discussion, student class participation, and classroom disorder formed an overall classroom instruction factor. The relationships among the latent variables, second-order factors, and instruction are shown in Figure 1.

The same factor loadings and path relationships were specified at the within-school level with the exception that student achievement was not included. The adequacy of the fit of this model was examined through a number of model fit indices, including the comparative fit index (CFI), the Tucker–Lewis index (TLI), and the root mean square error of approximation (RMSEA).⁴ The initial model did not adequately fit the data. Changes to the initial model were made based on model modification indices as well as multilevel exploratory factor analysis of the latent variable. Accordingly, changes were made to the within-school specification, where the instructional latent variables loaded onto two separate factors. Critical thinking in assignments and quality of student discussion loaded onto a factor we termed academic demands, whereas student responsibility and classroom disorder loaded onto a separate factor that we labeled classroom order. Similarly, the components of professional community, collective responsibility, and orientation toward innovation loaded onto one factor, whereas the three other measures, reflective dialogue, teacher socialization, and peer collaboration, loaded onto a separate factor. The components of student learning climate did not load onto a single factor and were better retained as separate variables. The fit indices for the final model indicate that the model has adequate fit to the data (CFI = .96, TLI = .95, RMSEA = .03). All latent variables at the between-school level were regressed on the school contextual variables. The final specification of the multilevel model that shows the between-school and the within-school relationships is described in Figure 1 and Figure 2.

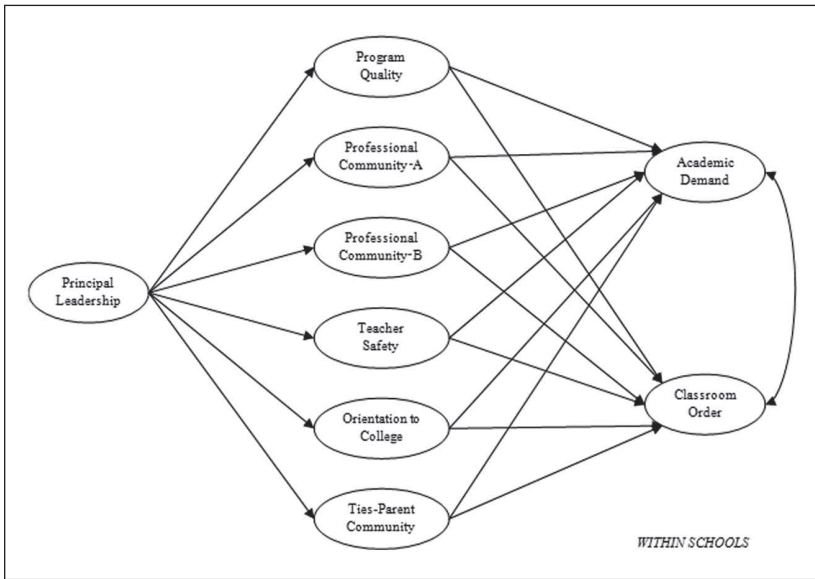


Figure 2. Within-school model of principal leadership, school organizational factors, and classroom instruction

Note. All school organizational factors are correlated with each other. Professional community–A is a factor from collective responsibility and orientation to innovation. Professional community–B is a factor composed of reflective dialogue, teacher socialization, and peer collaboration

Results

We focus our attention on the direct and indirect pathways from principal leadership to classroom instruction and student learning. The research questions are addressed with the direct and indirect pathways displayed in Tables 2 and 3. The coefficients shown in these tables are the standardized model results, representing the change in an outcome variable in standard deviation units for every unit change (also in standard deviations) of a predictor variable. The analyses yield many additional coefficients, beyond the pathways from principal leadership to instruction and learning, because of the complexity of the models. The full results of the SEM models are provided in Appendix C (within school model) and Appendix D (between school model).

We begin by looking at differences in instruction and student achievement across schools with the between-school model. Principal leadership is associated

Table 2. Direct and Indirect Relationships of Principal Leadership With Instruction and Learning, Between Schools

Panel 1: Quality of Classroom Instruction						
Predictor		Via		Outcome	<i>b</i>	SE
Principal leadership	→	(direct)	→	Classroom instruction	-0.17	(0.24)
Principal leadership	→	Parent and community ties	→	Classroom instruction	-0.03	(0.03)
Principal leadership	→	Professional community	→	Classroom instruction	-0.11	(0.17)
Principal leadership	→	Program quality	→	Classroom instruction	0.21	(0.38)
Principal leadership	→	Learning climate	→	Classroom instruction	0.25	(0.09)**

Panel 2: Education Planning and Assessment System (EPAS) Controlling for Prior Achievement							
Predictor		Via (Pathway 1)		Via (Pathway 2)	Outcome	<i>b</i>	SE
Principal leadership	→	(direct)	→	Classroom instruction	→ EPAS	-0.11	(0.15)
Principal leadership	→	Parent and community ties	→	Classroom instruction	→ EPAS	-0.02	(0.02)
Principal leadership	→	Professional community	→	Classroom instruction	→ EPAS	-0.07	(0.10)
Principal leadership	→	Program quality	→	Classroom instruction	→ EPAS	0.14	(0.23)
Principal leadership	→	Learning climate	→	Classroom instruction	→ EPAS	0.16	(0.06)**

Panel 3: GPA Controlling for Prior Achievement							
Predictor		Via (Pathway 1)		Via (Pathway 2)	Outcome	<i>b</i>	SE
Principal leadership	→	(direct)	→	Classroom instruction	→ GPA	-0.14	(0.19)
Principal leadership	→	Parent and community ties	→	Classroom instruction	→ GPA	-0.02	(0.02)
Principal leadership	→	Professional community	→	Classroom instruction	→ GPA	-0.09	(0.13)
Principal leadership	→	Program quality	→	Classroom instruction	→ GPA	0.17	(0.30)
Principal leadership	→	Learning climate	→	Classroom instruction	→ GPA	0.21	(0.08)*

p* < .05. *p* < .01.

with instruction and student outcomes through just one primary mechanism—the school learning climate. The top panel in Table 2 shows the direct and indirect

Table 3. Direct and Indirect Relationships of Principal Leadership With Instruction, Within Schools

Panel 1: Within-School Direct and Indirect Relationships With Academic Demand						
Predictor		Via		Outcome	<i>b</i>	SE
Principal leadership	→	(Direct)	→	Academic demand	-0.10	(0.05)*
Principal leadership	→	Safety	→		0.03	(0.01)**
Principal leadership	→	Parent and community ties	→		0.03	(0.01)***
Principal leadership	→	College expectations	→		0.07	(0.01)***
Principal leadership	→	Professional community-A	→		-0.01	(0.02)
Principal leadership	→	Professional community-B	→		0.05	(0.02)**
Principal leadership	→	Program quality	→		0.19	(0.05)***
Panel 2: Within-School Direct and Indirect Relationships With Classroom Order						
Predictor		Via		Outcome	<i>b</i>	SE
Principal leadership	→	(Direct)	→	Classroom order	0.03	(0.05)
Principal leadership	→	Safety	→		0.10	(0.01)***
Principal leadership	→	Parent and community ties	→		0.01	(0.01)*
Principal leadership	→	College expectations	→		0.07	(0.01)***
Principal leadership	→	Professional community-A	→		-0.02	(0.02)
Principal leadership	→	Professional community-B	→		-0.01	(0.02)
Principal leadership	→	Program quality	→		0.14	(0.06)*

* $p < .05$. ** $p < .01$. *** $p < .001$.

pathways through which leadership is related to differences between schools in the quality of classroom instruction. The only path that is significant is the indirect path through school learning climate. Schools where teachers rate their principals highly are more likely to have strong learning climates; schools with strong learning climates are more likely to have strong instruction. The total indirect relationship of leadership with classroom instruction is positive (0.25) and significant. The degree to which principals are successful at creating

a strong learning climate in the school seems to be the most important way in which they influence the average quality of instruction in the school. High school principals do not seem to influence the overall quality of instruction in a school through other mechanisms. There are no significant direct or indirect paths of influence through interaction with parents, professional community, quality of programs, and professional development.

The positive relationship of principal leadership and instruction through the school learning climate carries through to explain differences in student achievement across schools. Panels 2 and 3 of Table 2 show the direct and indirect relationships of principal leadership with student achievement as measured through gains on the EPAS and average GPA. Recall that the SEM models are specified such that only classroom instruction has a direct relationship with student achievement because all other measures are constrained to have indirect relationships with student achievement through classroom instruction. The first row in Panel 2, for example, is the indirect relationship of principal leadership with test scores via classroom instruction. The second row is the indirect relationship of leadership with test scores via parent–community ties and classroom instruction. Again, it is only the indirect relationship of principal leadership via the school learning climate and classroom instruction that is significantly related to GPA and EPAS outcomes. Leadership has small, positive indirect relationships with test scores (EPAS gains) as well as GPAs through the school learning climate.⁵

Taking schools as a whole, principal leadership is associated with the overall quality of instruction only through the school climate. However, the within-school models suggest that principals influence the instructional quality of individual teachers through a number of different mechanisms. Table 3 shows the direct and indirect relationships of leadership with two elements of classroom instruction—academic demands and classroom order—across teachers within the same school. Comparing differences in instructional quality within schools, principal leadership has significant, positive relationships with both academic demand and classroom order via school safety, parent ties, high college expectations, and program quality. The strongest indirect relationships come through program quality, which is defined as the quality of professional development and program coherence. Academic demand and classroom behaviors are better among those teachers who believe they have received high-quality professional development and where the instructional programming in the school is coherent and well aligned. Teachers who perceive that school climate is good relative to other teachers in the school are also more likely to have better instructional environments in their classrooms. In particular, teachers who feel there are strong expectations for college are

more likely to report high academic demands, whereas teachers who feel the school is safe are more likely to report having orderly classrooms. The indirect relationships of leadership with individual teachers' instruction, through perceptions of safety and college expectations, are small but significant. Certain aspects of professional community—teacher collaboration, socialization of new teachers, and reflective dialogue—are also related to academic demands, showing that those teachers who work more collaboratively with other teachers tend to have higher academic demands compared to other teachers in the school.

There is also a direct relationship of principal leadership with classroom academic demands, net of all of the mediating factors. Academic demands tend to be *lower* in classrooms where teachers report stronger instructional relationships with the principal, holding constant the principal leadership's influence with instruction through the other factors (learning climate, program quality, etc.). This path represents principals' direct involvement with instruction, over and above their work to improve parent involvement, school climate, professional community, or program quality. It may indicate that principals take more time to work with teachers who have particularly low levels of academic demand in their classes. It could also indicate that principals' efforts through mechanisms other than parent involvement, school culture, and professional community are counterproductive to increasing academic demands.

Discussion

This research builds on existing empirical work examining the relationship of principal leadership with classroom instruction and student learning. Consistent with this body of research, this study finds that when comparing averages across schools, the relationships of principal leadership with instruction and learning are indirect and small. The study shows that the mediating school processes described in the framework for essential supports are all important for improving instruction and learning but that they operate in different ways. At the between-school level, when comparing one school to another, principal leadership is related to the overall quality of instruction and student achievement through only one mechanism—the learning climate. Schools with stronger leaders are more likely to be safe and orderly and to have a college-going culture than other schools serving similar populations of students. These differences in school climate yield classes that have better student behavior and greater academic demands. In turn, students gain more on tests and have higher grades. Many prior studies of school leadership have been limited by studying only a few aspects of school organization

at a time. When considering several mediating factors together, only the school learning climate is associated with differences in learning gains between schools.⁶

It makes some intuitive sense that principal leadership has the greatest association with the overall quality of instruction and student achievement through the school learning climate. School climate affects all classrooms and so may have the broadest reach across the many different classes in a school. Other research has shown the importance of an orderly climate for student learning; studies of classroom instruction have shown that classroom management (routines, order, and student behavior) and expectations (challenge, academic press) are perhaps the most important elements of the classroom for student learning (Bill and Melinda Gates Foundation, 2011; Kane, Taylor, Tyler, & Wooten, 2010). Even very qualified teachers are unlikely to show high learning gains in schools that are disorderly and unsafe (DeAngelis & Presley, 2011). Likewise, research has shown that urban students are more likely to succeed when they attend schools with a strong college-oriented culture, with high expectations and supportive organizational norms and structures (Roderick, Coca, & Nagaoka, 2011). Efforts to improve learning climate do not rely on subject-specific skills or understanding. Principals in high schools may not have the skills to direct instructional practice in all subjects, but they can create a climate in which teachers in all subjects can be successful. Particularly in urban districts, like Chicago, where there is considerable variation across schools' learning climates, principal leadership can have a strong impact through this dimension.

This finding has implications for the ways in which principals organize their work and for training new leaders. If the primary mechanism for improving student achievement comes through the school learning climate, then this implies that principals need to make school climate the priority in their school improvement efforts. This also implies that training programs that prepare principals to lead urban schools need to recognize learning climate as a priority. At the same time, this does not mean that other aspects of principals' roles are unimportant. When we consider the relationship of principal leadership and instruction within schools—comparing one teacher to another—several mediating factors, including the quality of professional development, professional community, and partnerships with parents, have significant associations with instructional quality. The quality of professional development has the strongest relationship. This suggests that principal leadership is important for assisting individual teachers to improve their performance, perhaps where principals feel help is most needed or where they prioritize school efforts and resources. However, because these efforts affect only individual teachers or subsets of teachers in a school, their overall influence on instruction and student

achievement across the entire school are small. A recent study of school leadership in Cyprus similarly argued that it may be easier for principals to change teachers' personal perceptions, behaviors, and values at an individual level than to change teachers' culture at the school level taken as a group (Kythreotis, Pashiardis, & Kyriakides, 2010).

Another finding in this study is that the indirect association of principal leadership on instruction is greater only through certain aspects of professional community—reflective dialogue, teacher socialization, and teacher collaboration. Furthermore, the direct relationship of principal leadership with instruction was not significant at the between-school level and negative at the within-school level. This suggests that at the high school level, principals' direct interaction with classroom instruction may be perceived as unhelpful by teachers. However, this association may appear simply because principals directly work more frequently with teachers whom they perceive as most needing assistance.

The results and conclusions from this study are limited by several weaknesses. First, only teacher self-reports were used for all measures except student learning outcomes. Furthermore, the self-reports were from annual surveys that ask teachers to summarize their experiences in schools over an entire school year. These artifacts of the study may introduce bias in the estimates shown in the study. The teacher surveys captured only certain aspects of instruction—academic demand, student discussion, student participation, and disruption in instruction. There are several important factors such as content, pacing, and time on task, but information on these dimensions was not collected in the CCSR surveys. The teacher surveys were developed to collect information about instruction without causing survey fatigue. Content coverage data were not collected because they entailed a considerable increase in survey length. Teachers also were not asked about other aspects of teaching such as providing student support, planning and implementing clear lessons, or attempts to make the class engaging, as it seems unlikely that they would be accurate respondents in these areas. As such, the teacher surveys tell us what teachers are trying to do and how their students are responding to those efforts.

Another limitation of this study is that it tests the importance of mediating factors controlling for the presence of other factors. Perhaps more useful is identifying the effects of having optimal combinations of several organizational factors existing together. Hallinger and Heck (2010a, 2010b) have noted the importance of dynamic models of school leadership using longitudinal data. They have also commented on the importance of accounting for reciprocal effects, whereby achievement gains influence good instruction, which in turn strengthens organizational structures around instruction and also boosts the leadership of the principal. Our ability to address these relationships is

limited by the cross-sectional nature of the data, except for student outcomes where we could account for students' prior ability. A final limitation is that the data for this study come from high schools in one large urban school district, which limits the generalizability of the findings to other settings.

These shortcomings point to future research that would build on this work. First, as progress is made on defining and measuring the black box of classroom instruction, research on the effects of leadership needs to keep pace. This study could be extended to include longitudinal data so that relationships are estimated not only for absolute levels but also for changes in leadership and the essential supports over time and growth in student learning gains. The model could also be extended to include perspectives other than those of the teacher such as student and principal perspectives. Finally, research into identifying optimal combinations of school organizational factors to promote instruction and learning involves considerable sophistication in statistical techniques. Methods such as latent class analysis and latent trajectory analysis can perhaps be utilized to do this.

Appendix A

Models of Student Outcomes

To estimate school average test scores and unweighted grade point averages adjusting for student background characteristics we used two-level hierarchical models. Level 1 represents students and level two represents schools.

Level 1 Model: Students

$$\text{Outcome}_{ij} = \pi_{0j} + \sum_{p=1}^q \pi_{pj} (X)_{ij} + e_{ij},$$

where the outcome is either the GPA or the students' composite test score on the PLAN or ACT. X is a vector of background variables including gender, a series of race/ethnicity dummy variables, the social status in the census block where the student lives, the concentration of poverty in his or her block, special education status, whether the student is old for his or her grade, his or her grade level, and whether the student ever changed schools. Prior ability was also included through a series of dummy variables representing the exact score on the most recent test of prior ability for each student, EXPLORE for 9th graders, PLAN-10 for 10th graders, and PLAN-11 for 11th graders. The slopes for these control variables do not vary randomly at the school level and are grand mean centered.

Level 2 Model: School (Instruction Measures)

$$\pi_{oj} = \beta_{oj} + r_{oj}$$

No covariates were entered as control variables for the HLMs as contextual variables such as size, average inking ability, and average socioeconomic status were directly included in the structural equation modeling models.

Appendix B

Survey Measures

Principal leadership	Instructional leadership reliability = .91	The principal: Makes clear to the staff his or her expectations for meeting instructional goals; Communicates a clear vision for our school; Sets high standards for teaching; Understands how children learn; Sets high standards for student learning; Presses teachers to implement what they have learned in professional development; Knows what's going on in my classroom
	Teacher-principal trust reliability = .89	The principal has confidence in the expertise of the teachers; I trust the principal at his or her word; It's OK in this school to discuss feelings, worries, and frustrations with the principal; The principal takes a personal interest in the professional development of teachers; The principal looks out for the personal welfare of the faculty members; The principal places the needs of children ahead of personal and political interest
Professional capacity: Program quality	Program coherence reliability = .79	Once we start a new program, we follow up to make sure that it's working; We have so many different programs in this school that I can't keep track of them all; Many special programs come and go at this school; You can see real continuity from one program to another at this school; Curriculum, instruction, and learning materials are well coordinated across the; different grade levels at this school; There is consistency in curriculum, instruction, and learning materials among; teachers in the same grade level at this school

(continued)

Appendix B (continued)

	<p>Quality of professional development reliability = .81</p>	<p>Teachers are left completely on their own to seek out professional development; Most of what I learn in professional development addresses the needs of the; students in my classroom; Most professional development topics are offered in the school once and not; followed up; Overall, my professional development experiences this year; Been sustained and coherently focused, rather than short-term and unrelated; Included enough time to think carefully about, try, and evaluate new ideas; Been closely connected to my school's improvement plan; Included opportunities to work productively with colleagues in my school; Included opportunities to work productively with teachers from other schools</p>
<p>Professional capacity: Professional community</p>	<p>Reflective dialogue reliability = .78</p>	<p>Teachers in this school regularly discuss assumptions about teaching and learning; Teachers talk about instruction in the teachers' lounge, faculty meetings, etc.; Teachers in this school share and discuss student work with other teachers; How often have you had conversations with colleagues on; What helps students learn the best; Development of new curriculum; The goals of this school; Managing classroom behavior</p>
	<p>Orientation to innovation reliability = .89</p>	<p>How many teachers in this school: Are really trying to improve their teaching; Are willing to take risks to make this school better; Are eager to try new ideas; All teachers are encouraged to "stretch" and "grow"; In this school, teachers are continually learning and seeking new ideas; In this school, teachers have a "can do" attitude</p>
	<p>Socialization of new teachers reliability = .57</p>	<p>Experienced teachers invite new teachers into their rooms to observe, give feedback, etc.; A conscious effort is made by faculty to make new teachers feel welcome here</p>

(continued)

Appendix B (continued)

	Peer collaboration reliability = .73	How often have you: Observed another teacher's classroom to offer feedback; Observed another teacher's classroom to get ideas for your own instruction; Gone over student assessment data with other teachers to make instructional decisions; Worked with other teachers to develop materials or activities for particular classes; Worked on instructional strategies with other teachers during common planning time
	Collective responsibility reliability = .91	How many teachers in this school: Help maintain discipline in the entire school, not just their classroom; Take responsibility for improving the school; Set high standards for themselves; Feel responsible to help each other do their best; Feel responsible that all students learn; Feel responsible for helping students develop self-control; Feel responsible when students in this school fail
Learning climate	Teacher safety reliability = .89	To what extent is each of the following a problem at your school: Physical conflicts among students; Robbery or theft; Vandalism; Gang activity; Disorder in classrooms; Disorder in hallways; Student disrespect of teachers; Threats of violence toward teachers
	Orientation toward postsecondary education reliability = .79	Teachers expect most students in this school to go to college; Teachers at this school help students plan for college outside of class time; The curriculum at this school is focused on helping students get ready for college; Most of our students have the capacity to do college level work; Most of the students in this school are planning to go to college; Teachers in this school feel that it is a part of their job to prepare students to succeed in college
Parent–community ties	Parent teacher interaction reliability = .58	How often have you done the following this school year: When a student performed poorly, you informed his/her parents; When a student performed poorly, you talked with his/her parents about ways; They could help their child learn; When a student performed better than usual, you informed his/her parents

(continued)

Appendix B (continued)

Classroom instruction	Student class participation reliability = .89	How many students in your Target class: Come to class on time; Attend class regularly; Come prepared with the appropriate supplies and books; Regularly pay attention in class; Actively participate in class activities; Always turn in their homework
	Classroom disorder reliability = .77	On a typical day how often is your class disrupted by . . . student misbehavior; announcements, messengers, students coming in tardy, noise in the hall
	Quality of student discussion reliability = .73	Students build on each other's ideas during discussion; Students use data and text references to support their ideas; Students show each other respect; Students provide constructive feedback to their peers/teachers; Students draw on relevant knowledge learned outside of class
	Critical thinking in assignments reliability = .73	How do you require students to turn in written assignments that: Use evidence to support their ideas; Clearly state a main thesis or argument; Demonstrate original thought, ideas, or analysis; Consider multiple solutions or perspectives; Synthesize information from multiple sources

Appendix C

Structural Equation Modeling Results (Within Schools)

Within-School Model Results (Standardized)

Factor Loadings		Estimate	SE	Est./SE	p Value
Principal leadership	(by)				
Instructional leadership		0.94	0.01	193.03	.00
Teacher–principal trust		0.90	0.01	164.83	.00
Academic demand	(by)				
Critical thinking in assignments		0.64	0.02	35.17	.00
Quality of student discussions		0.87	0.02	42.03	.00
Classroom order	(by)				
Class participation		0.70	0.02	37.24	.00
Classroom disorder		0.59	0.02	29.01	.00

(continued)

Appendix C (continued)

Within-School Model Results (Standardized)

Factor Loadings		Estimate	SE	Est./SE	p Value
Professional community–A	(by)				
Collective responsibility		0.83	0.01	99.98	.00
Orientation to innovation		0.99	0.01	144.57	.00
Professional community–B	(by)				
Reflective dialogue		0.80	0.01	67.25	.00
Socialization of new teachers		0.64	0.01	47.42	.00
Peer collaboration		0.65	0.01	47.09	.00
Program quality	(by)				
Program coherence		0.79	0.01	72.88	.00
Quality of professional development		0.76	0.01	55.98	.00
<i>regressions</i>					
Academic demand	(on)				
Professional community–A		–0.02	0.03	–0.79	.43
Professional community–B		0.11	0.04	2.96	.00
Program quality		0.24	0.07	3.67	.00
Principal leadership		–0.10	0.05	–2.23	.03
Classroom order	(on)				
Professional community–A		–0.03	0.03	–0.81	.42
Professional community–B		–0.03	0.03	–0.85	.39
Program quality		0.18	0.07	2.45	.01
Principal leadership		0.03	0.05	0.50	.62
Professional community–A	(on)				
Principal leadership		0.61	0.02	26.06	.00
Professional community–B	(on)				
Principal leadership		0.46	0.03	17.85	.00
Program quality	(on)				
Principal leadership		0.81	0.01	67.96	.00
Academic demand	(on)				
Orientation to postsecondary ed.		0.15	0.03	5.83	.00
Teacher safety		0.08	0.02	3.29	.00
Parent teacher interaction		0.17	0.03	6.86	.00
Classroom order	(on)				
Orientation to postsecondary ed.		0.15	0.03	5.05	.00
Teacher safety		0.30	0.03	11.18	.00
Parent teacher interaction		0.06	0.03	1.99	.05

(continued)

Appendix C (continued)

Within-School Model Results (Standardized)

Factor Loadings		Estimate	SE	Est./SE	p Value
Orientation to postsecondary ed.	(on)				
Principal leadership		0.46	0.02	23.97	.00
Teacher safety	(on)				
Principal leadership		0.35	0.02	19.74	.00
Parent teacher interaction	(on)				
Principal leadership		0.17	0.02	8.79	.00
Correlations					
Professional community–A	(with)				
Professional community–B		0.46	0.03	16.73	.00
Program quality		0.31	0.03	10.72	.00
Orientation to postsecondary ed.		0.30	0.02	14.34	.00
Teacher safety		0.10	0.02	6.00	.00
Parent teacher interaction		0.20	0.02	10.10	.00
Professional community–B	(with)				
Program quality		0.37	0.03	10.93	.00
Orientation to postsecondary ed.		0.23	0.03	8.51	.00
Teacher safety		0.02	0.02	0.82	.41
Parent teacher interaction		0.26	0.02	11.59	.00
Program quality	(with)				
Orientation to postsecondary ed.		0.33	0.03	11.96	.00
Teacher safety		0.30	0.03	12.19	.00
Parent teacher interaction		0.21	0.03	7.00	.00
Academic demand	(with)				
Classroom order		0.54	0.03	17.01	.00
Orientation to postsecondary ed.	(with)				
Teacher safety		0.16	0.02	8.44	.00
Parent teacher interaction		0.15	0.02	8.43	.00
Teacher safety	(with)				
Parent teacher interaction		0.02	0.02	0.94	.35

Appendix D

Structural Equation Modeling Results (Between Schools)

Between-School Model Results (Standardized)

Factor Loadings		Estimate	SE	Est./SE	p Value
Principal leadership	(by)				
Instructional leadership		1.00	0.00	—	.00
Teacher–principal trust		0.94	0.02	59.34	.00
Professional community					
Collective responsibility	(by)	0.99	0.01	98.47	.00
Orientation to innovation		0.99	0.01	88.57	.00
Reflective dialogue		0.71	0.12	5.94	.00
Socialization of new teachers		0.86	0.05	16.16	.00
Peer collaboration		0.51	0.13	4.01	.00
Program quality	(by)				
Program coherence		0.88	0.06	13.75	.00
Quality of professional development		0.90	0.07	12.49	.00
Regressions					
Classroom instruction	(on)				
Critical thinking in assignments		0.87	0.06	15.85	.00
Quality of student discussions		0.90	0.04	23.18	.00
Classroom disorder		0.92	0.03	26.93	.00

(continued)

Appendix D (continued)

Between-School Model Results (Standardized)

Factor Loadings	Estimate	SE	Est./SE	p Value
Class participation	0.98	0.02	50.98	.00
Learning climate (on)				
Teacher safety	0.89	0.02	37.60	.00
Orientation to postsecondary ed.	1.00	0.00	—	.00
Classroom instruction (on)				
Principal leadership	-0.17	0.24	-0.71	.48
Professional community	-0.19	0.28	-0.69	.49
Program quality	0.25	0.44	0.58	.56
Learning climate	0.83	0.13	6.29	.00
Professional community (on)				
Principal leadership	0.60	0.10	6.08	.00
Program quality (on)				
Principal leadership	0.86	0.06	13.94	.00
Learning climate (on)				
Principal leadership	0.31	0.09	3.44	.00
Classroom instruction (on)				
Parent teacher interactions	-0.11	0.08	-1.39	.16
School size	0.18	0.08	2.28	.02
School context	0.23	0.10	2.23	.03
Learning climate (on)				
School size	-0.43	0.11	-3.79	.00
School context	0.72	0.06	11.17	.00
Professional community (on)				
School size	-0.25	0.09	-2.80	.01
School context	0.18	0.11	1.72	.09

(continued)

Appendix D (continued)

Between-School Model Results (Standardized)

Factor Loadings		Estimate	SE	Est./SE	p Value
Program quality	(on)				
School size		-0.04	0.07	-0.56	.58
School context		0.00	0.13	-0.01	.99
Principal leadership	(on)				
School size		-0.04	0.13	-0.26	.79
School context		-0.03	0.17	-0.16	.87
Average GPA	(on)				
Classroom instruction		0.81	0.16	5.07	.00
Average EPAS	(on)				
Classroom instruction		0.63	0.12	5.49	.00
Parent teacher interaction	(on)				
Principal leadership		0.25	0.14	1.74	.08
Average GPA	(on)				
School size		-0.20	0.08	-2.60	.01
School context		-0.57	0.14	-4.12	.00
Average EPAS	(on)				
School size		0.02	0.06	0.30	.76
School context		0.30	0.12	2.49	.01
Parent teacher interaction	(on)				
School size		0.00	0.12	0.00	1.00
School context		-0.08	0.14	-0.58	.56
Correlations	(with)				
Professional community					
Program quality		0.82	0.12	6.99	.00
Learning climate		0.64	0.08	8.16	.00
Parent teacher interaction		0.11	0.18	0.63	.53

(continued)

Appendix D (continued)

Between-School Model Results (Standardized)

Factor Loadings	Estimate	SE	Est./SE	p Value
Program quality	(with)			
Learning climate	0.49	0.13	3.77	.00
Parent teacher interaction	0.19	0.24	0.78	.43
Learning climate	(with)			
Parent teacher interaction	0.06	0.15	0.40	.69
Average GPA	(with)			
Average EPAS	-0.03	0.13	-0.25	.80

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Notes

- Hallinger and Heck (1996, 1998) organized studies of principal leadership into three areas: (a) studies of direct effects of leadership on student outcomes, (b) studies in which effects of leadership are mediated by other variables, and (c) studies in which principals, teachers, and school organizational factors influence each other as well as student learning. Although their review found little evidence for direct effects of principal leadership, they found that indirect effects of principal leadership were significant, albeit small. Witziers, Bosker, and Kruger (2003) conducted a meta-analysis of 37 studies of direct effects of leadership on student outcomes and found small direct effects for elementary schools but no effects for secondary schools.
- Hallinger, Bickman, and Davis (1996) examined the mediating role of instructional climate that included student opportunities to learn as well as teacher expectations.
- Specifying the hierarchical linear model in this way allows us to examine the relationship of classroom instruction with achievement after controlling for the characteristics of students. The final structural equation models also control for school

contextual characteristics such as average incoming ability levels of students. We may find, for example, that high academic demand is associated with high learning gains. But if only students with very high achievement experience classrooms with high demand, this relationship may exist only for students with high achievement. Unless we control for the composition of students in the school, we cannot know that it is the instructional element, rather than the school composition, that is associated with higher learning. This, however, is an overly conservative test of the relationship between instruction and achievement since the ways that composition affects the learning climate actually should affect student achievement.

4. The cutoff criteria for good fit are conventionally set at .95 for the comparative fit index and Tucker–Lewis index and .06 for root mean square error of approximation (Hu & Bentler, 1999).
5. These estimates are based on the between-school variances in test scores and GPA. In relation to the overall variance of test scores and GPA, between-school variance is small. Schools account for about 13% of the overall variance in unadjusted GPA and 37% of the overall variance in unadjusted test score gains. After controlling for student-level characteristics, schools account for only 4.93% of the variance in GPA and 7.89% of the variance in test score gains.
6. We tested alternate models where we left out different mediating processes. For example, we ran a model where professional community was the only mediating process. In that model, we found that the indirect relationship of leadership with student learning via professional community was positive and statistically significant, a finding consistent with Supovitz, Sirinides, and May (2010). However, once we also include learning climate as a mediating factor, this relationship becomes nonsignificant. The indirect relationships between leadership and learning are not significant when parent–community ties and program quality are the only mediating variables in the model.

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