A Theoretical and Empirical Analysis of the Roles of Instructional Leadership, Teacher Collaboration, and Collective Efficacy Beliefs in Support of Student Learning

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Principals' instructional leadership may support the degree to which teachers work together to improve instruction, and together leadership and teacher collaboration may contribute to school effectiveness by strengthening collective efficacy beliefs. We found a significant direct effect of leadership on teacher collaboration. Further, leadership and collaboration predicted collective efficacy beliefs. Finally, achievement differences among schools were predicted directly by collective efficacy beliefs and indirectly by instructional leadership and teacher collaboration. These findings suggest that strong instructional leadership can create structures to facilitate teachers' work in ways that strengthen organizational belief systems, and, in concert, these factors foster student learning.

Introduction

In this study, we employ social cognitive theory to integrate several promising lines of research that have previously separately positioned school organiza-

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tional features as predictors of student achievement. Social cognitive theory is based on the premise that behavior functions within a triadic reciprocal relationship involving cognition, behavior, and the environment. People learn via a combination of observing others, making sense of what they see, and reacting to conditions within their environment. Self-regulation, self-motivation, and self-efficacy are individual-level constructs associated with social cognitive theory. Bandura (1993, 1997) postulated four sources of efficacy beliefs: enactive (mastery) experiences, social persuasion, vicarious learning, and affective states. Recent research on efficacy belief-shaping information indicates that enactive experiences may be the most powerful of the four sources (Tschannen-Moran and Hoy 2007; Tschannen-Moran and McMaster 2009).

Our work is situated within social cognitive theory with a particular emphasis on the enactive experiences of teachers. Enactive experience refers to the lived experience of individuals whereby the greater the degree to which these experiences suggest individual or collective mastery (i.e., positive enactive experiences), the more likely, according to social cognitive theory, efficacy beliefs will be strengthened. Although previous studies suggest that transformational leadership is related to collective efficacy beliefs (Ross and Gray 2006), this study did not examine teachers' experience with transformational leadership as a potential cause of student achievement. To offer a focus on the potential causes and effects of teachers' instructional improvement work, we develop

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and test a social cognitive theoretical model that not only links perceived collective efficacy to student learning but also tests the link from school leadership to collective efficacy through teacher collaboration. Instrumental to this analysis is the role of teacher collaboration because it constitutes a key form of enactive experience in schools, which social cognitive theory positions as critical to the development of the professional capabilities about which efficacy beliefs refer (Bandura 1982). In addition, we test the link from principals' instructional leadership to collective efficacy beliefs through collaboration. Below, we briefly introduce several other factors that motivate this work and summarize its original contributions.

We chose to focus on school leadership because of recent meta-analytic research reviews that demonstrate compelling evidence of a positive link between principal leadership and student achievement (Robinson et al. 2008; Waters et al. 2003). Our work differs from the majority of leadership-achievement studies in a key way, however. Specifically, studies of the influence of school leadership on achievement often fail to analyze what teachers do to become more effective because of strong leadership. We address this problem by examining whether school leadership affects the ways in which teachers work together to improve instruction. We chose this focus in part because of recent findings that teacher collaboration is positively related to differences among schools in student mathematics and reading achievement (Goddard et al. 2007) and because of more recent work suggesting that teacher collaboration mediates the relationship between leadership and achievement in schools (Goddard et al. 2010). In light of this research, one of our guiding questions is whether school principals can lead in ways that foster teacher collaboration for instructional improvement.

Indeed, we reason that the more that principals serve as instructional leaders with detailed knowledge of classroom practice, the more likely are teachers to engage in collaborative interactions designed to improve instruction and facilitate group goal attainment. School leaders may serve as a catalyst for teacher collaboration. Leaders are crucial in providing support for collaboration's significant time commitments. Further, leader knowledge of effective instructional practices is important. For example, based on a meta-analytic study, Hallinger (2005) proposed an instructional leadership model that included, among other aspects, that leaders manage the instructional program and promote a positive learning climate. In the context of this article, these factors are linked such that principals' knowledge of teaching and learning will lead them to set up structures, such as teacher collaboration, that are designed to support effective instruction. In fact, Robinson and colleagues (2008) concluded that leaders' work on relationship building with increased involvement in teaching and learning could result in improved outcomes for students. As we

review below, this link between instructional leadership and teachers' collaborative work to improve their practice is based on considerable evidence that school leaders can provide support promoting instructional improvement and thus student achievement.

We ground our perspective in social cognitive theory (Bandura 1982, 1997), which positions enactive experience—principals' and teachers' work in the present case—as the most potent form of efficacy belief-shaping information. Teacher collaboration is a key to the pathway from leadership to collective efficacy beliefs because it is the shared interactions among group members that serve as the building blocks of collective efficacy. Strong instructional leadership can also serve to influence collective efficacy indirectly by setting normative expectations for formal, frequent, and productive teacher collaboration around instructional improvement. Moreover, when teacher collaboration is centered on instructional improvement in schools, it is more likely to build real capability and hence enhance the resolve of teachers that they possess the ability necessary to achieve student learning goals. From the perspective of social cognitive theory, leadership that establishes such norms also serves as a form of social persuasion that can positively influence collective efficacy beliefs.

Thus, unlike earlier studies that document a relationship between collective efficacy beliefs and academic achievement in schools (Bandura 1993; Goddard et al. 2000, 2004), our work is designed to also examine school leadership and teacher collaboration as malleable factors capable of influencing collective efficacy beliefs. Moreover, we place a particular focus on teacher collaboration as a key instrumental variable by employing a measure that captures its intensity, influence, and focus on instruction.

In sum, we use social cognitive theory to develop and test a model that not only links collective efficacy beliefs to student learning but also tests the link from school leadership to collective efficacy through teacher collaboration. By approaching the problem of school improvement in this way, we accomplish several important goals. First, we develop a social cognitive theoretical rationale for the connection between school leadership and teachers' work, thus partly unpacking the black box between leadership and student achievement. Second, we build on previous research to advance a robust multidimensional model of teachers' collaborative instructional improvement work that enables us to test its relations to principal leadership, collective efficacy, and student achievement. Third, we interpret our conceptual model of teacher collaboration not only in terms of its associations with student achievement and school leadership but also by testing whether the enactive experience of collaboration has consequences for collective efficacy beliefs in schools. Fourth, we offer original contributions to research on social cognitive theory by conducting explicit empirical tests of the ways in which principals and teachers may interact to

develop collective efficacy beliefs in schools. We turn next to a review of the theoretical foundations and extant literature that guide this research.

Theoretical Framework and Literature Review

In this section, we first discuss the constructs of instructional leadership, teacher collaboration, and perceived collective efficacy separately and then consider the ways in which these constructs interact through the lens of social cognitive theory. Finally, we present the rationale for the hypotheses on which this study is based.

Principals' Instructional Leadership

Scholars have demonstrated empirically that the work of school leaders has indirect effects on student achievement, mostly through the support leaders provide to teachers (Hallinger 2003, 2005; Leithwood and Mascall 2008; Louis et al. 2009). Indeed, Leithwood and colleagues (2004) concluded that school leadership was second only to teaching among school-based factors having the capacity to improve student performance.

Hallinger and colleagues (1996) found that principals had indirect effects on school effectiveness through their influence on the school learning climate. They suggest that researchers should consider mediating factors when examining the impact of principals on student achievement. Witziers and colleagues (2003) found small, direct effects of elementary school principal leadership on achievement but no such effects at the secondary school level. Although they signal the importance of principal leadership, none of these studies directly considered whether principal leadership was related to teachers' collective work, a gap we address in this study. This is an important connection to interrogate, given that research on principal leadership indicates the importance of encouraging teachers to work together actively toward instructional improvement (Marks and Printy 2003; Supovitz et al. 2010). Therefore, we have designed our study to position principal leadership, as did Bryk and colleagues (2010), as a primary driver of school improvement. We posit that schools in which principals are reported by teachers to frequently monitor instruction and provide strong instructional support are the ones most likely to be characterized by high levels of collective work among teachers to improve instruction. Specifically, we ask whether the level of collaborative instructional improvement work among teachers is affected by principals' instructional leadership. Along these lines, we turn next to an examination of research on teacher collaboration.

Teacher Collaboration for Instructional Improvement

Teachers work together for various purposes and in many configurations. Further, initiatives such as professional development communities and team teaching or coteaching provide unique opportunities for teachers to focus on common problems in their work. In this study, we define teacher collaboration for instructional improvement as a multidimensional construct that incorporates a focus on instructional policy, frequency of collaboration, and levels of formality characterizing the nature of teachers' collaborative work. Together, these dimensions form a broader construct representing the degree to which teachers work formally and frequently on instructional improvement. The core of our argument is that a consistent emphasis on instructional leadership can support teachers' collaborative work to improve instruction, which in turn supports collective efficacy beliefs and group success.

If collaboration among teachers is important, we argue that the frequency of such interactions is a key reflection of its intensity. That is, if collaboration occurs but rarely, we would expect its impact on instructional improvement to be substantively diminished. Similarly, if collaboration is expected but formal structures do not support it, its occurrence will likely be largely organic and random, appearing sometimes in the cafeteria or hallways and sometimes not at all. Although we believe in the potential power of informal professional networks and norms for collaboration, we have chosen in this study to examine formal collaboration for the reasons discussed here and because we are specifically looking at the link between principal leadership—a formal responsibility—and teachers' collaboration experiences.

Several studies have documented positive outcomes of teacher collaboration. For example, when first-year teachers have opportunities to collaborate on instructional practices, they are less likely to leave the profession or transfer to another school (Kardos and Johnson 2007; Youngs et al. 2011). Other desired outcomes of collaboration for teachers include improved efficacy (Pounder 1999; Shachar and Shmuelevitz 1997); improved attitudes toward teaching (Brownell et al. 1997); higher job satisfaction (Pounder 1999); and higher levels of trust in principals, colleagues, and clients (Tschannen-Moran 2001). Further, Smylie and colleagues (Smylie 1994; Smylie et al. 1996) found that student outcomes improved when teachers were involved in the development of curriculum and instruction. More recently, researchers have connected teacher collaboration with improved student achievement (Goddard et al. 2007; Louis et al. 2009). For example, Goddard et al. (2007) surveyed 452 teachers in 47 elementary schools and, after controlling for student characteristics and school social context, demonstrated that teacher collaboration was a significant positive predictor of differences among schools in student

achievement. In this study, teacher collaboration was focused on school instructional improvement but did not include measures of the frequency or formality of teacher collaboration. Our current work builds on such prior research by developing a multidimensional measure of collaboration that addresses all of these facets of collaborative work. In particular, we posit that indicators of collaboration should involve the frequency with which teachers collaborate as well as the degree to which their interactions are formally structured. That is, we argue for the importance of frequent and structured teacher work on instructional improvement to sustain school improvement.

Research also indicates that school leadership may have strong implications for the degree to which collaboration among teachers occurs. For example, Hausman and Goldring (2001) argue that meaningful change requires teacher input. But such structures do not occur without leadership to support them. Thus, leaders would do well to involve teachers in making key decisions about changes that can impact instruction in their schools. At a minimum, teachers are likely to require administrative support to help overcome barriers such as time, structure, and social affirmation so that they may engage fully in meaningful collaboration (Darling-Hammond and Richardson 2009). Teachers' collective work around these problems is thus only possible when local leadership facilitates and supports teachers' instructional efforts (Wahlstrom and Louis 2008). We also argue that such work constitutes the type of experience required to strengthen collective efficacy beliefs and increase resiliency in schools.

Collective Efficacy Beliefs

According to social cognitive theory (Bandura 1997), efficacy beliefs influence the degree of persistence and creativity with which individuals and groups approach prospective tasks. Bandura postulated four primary sources of efficacy belief-shaping information: enactive experience, vicarious experience, social persuasion, and affective state. Collective efficacy beliefs thus arise from a metacognitive process in which group members assess the relationship between their competence and the nature of the task they face in light of these sources of efficacy belief-shaping information (see Tschannen-Moran et al. 1998 for a review). It is important to note that several studies have documented that collective efficacy is predictive of student achievement in schools (Bandura 1993; Goddard 2001; Goddard et al. 2000). Furthermore, in the few studies that have examined predictors of collective efficacy, enactive experience, operationalized as prior achievement, has been the variable that most strongly predicts collective efficacy (e.g., Bandura 1993; Goddard 2001). For example, using sur-

veys from teachers in 45 K–5 grade schools in a large Midwestern urban school district, Goddard (2001) found that group mastery experience was significantly and positively related to differences among schools in collective efficacy beliefs. Although social cognitive theory specifies enactive experience as a key influence on collective efficacy beliefs, research evidence regarding the influence of actual enactive experience (as opposed to prior achievement) on collective efficacy beliefs is scant. Therefore, we posit that teacher collaboration—a key form of enactive experience conceptualized in this study—is associated with collective efficacy beliefs in schools.

Connecting Leadership, Teacher Collaboration, and Collective Efficacy Beliefs: A Social Cognitive Theoretical Perspective

To situate our study theoretically, we review the connections among leadership, teacher collaboration, and the social cognitive theoretical foundations upon which the study of collective efficacy beliefs is grounded. School leaders do indeed influence teachers' practices and set norms that may support collective efficacy beliefs (Ross and Gray 2006). In any organization, skills and expertise are often recognized as belonging to myriad personnel rather than a single person or small group. Moreover, uncoordinated practice and isolated classrooms are relics of twentieth-century education not positioned to support the forms of organizational learning required for schools to meet the demands for improvement they face. Thus, we argue that school environments may be most productive when principals work collaboratively with teachers to develop collective expertise. This is also a means of recognizing that school leadership, as suggested by Spillane (2006), is distributed among both formal and informal leaders. Also supporting the importance of teachers' common work, Smylie and colleagues (Smylie 1994; Smylie et al. 1996) found that student outcomes improved when teachers were collectively involved in the development of curriculum and instruction. Likewise, Louis and colleagues (2009) found a direct impact of principal leadership on teachers' professional community. Further, professional community was associated with improvements in math achievement on state assessments. Thus, research supports the importance of connections between leadership and teachers' collaborative practice.

Such connections also make sense from the perspective of social cognitive theory. For example, leaders can set normative expectations for instructional improvement via their ability to put processes and structures in place that provide productive enactive experiences for teachers. For example, Blase and Blase (2000) observed that effective principals focused on connections between both social and professional exchanges. These school leaders encouraged open communication, guiding teachers to reflect critically on their own

learning and teaching practice. Such research suggests strong connections between the practices principals enact daily and the work of teachers. Thus, we reason that the more principals work routinely with teachers on instructional improvement, the more likely are principals to be positioned socially to share best practices and connect teachers around the core of their work. Based on social cognitive theory, we suggest that both instructional leadership and teacher collaboration are key forms of enactive experience that influence collective efficacy beliefs and thus student achievement in schools.

Rationale for Hypotheses

Notably, some scholars have provided empirical evidence that the relationship between school leadership and student achievement is indirect and mediated by the support leaders provide to teachers (Hallinger 2003, 2005; Leithwood and Mascall 2008; Louis et al. 2009). For example, Hallinger and colleagues (1996) found that instructional leadership was positively related to students' achievement when principals' attention was devoted to the organization and evaluation of instruction. Given this, we reason that the first way in which school leaders can influence achievement is through their stimulation of frequent teacher collaboration around instructional improvement. Thus, we hypothesize that instructional leadership should positively predict the degree to which teachers work together to improve outcomes for their students.

To our knowledge, no previous research examining the predictors of collective efficacy beliefs in schools has grounded the conceptualization of enactive experience in factors over which teachers and leaders have direct control in their daily work, particularly as this work relates to instructional improvement. To address this, we consider teacher collaboration around instructional improvement and principals' instructional leadership as forms of enactive experience that, according to social cognitive theory, should be related positively to collective efficacy beliefs in schools. Therefore, we test the assumption of social cognitive theory that enactive experience, measured in the forms of instructional leadership and teacher collaboration, influences the levels of collective efficacy beliefs in schools.

Finally, consistent with previous research, we expect that collective efficacy beliefs should be positively and significantly related to differences among schools in student achievement. We differentiate our work, however, by embedding the construct of collective efficacy in a broader framework that not only predicts collective efficacy beliefs from the professional actions of principals and teachers but also connects teachers' collective efficacy beliefs to student achievement in a multilevel structural framework. Because we hypothesize that principal leadership and teacher collaboration should predict

collective efficacy, we expect that both will be positively and significantly related—indirectly—to student achievement through collective efficacy. Indeed, as we discuss more fully below, the multilevel structural equation modeling analytic approach we employ provides tests of the statistical significance of all the direct and indirect relationships we describe here.

In sum, based on the social cognitive theoretical underpinning sketched here, we designed this study to test the following hypotheses:

1. School principals' instructional leadership is positively and significantly associated with teacher collaboration for instructional improvement.
2. Teacher collaboration is positively and significantly related to collective efficacy beliefs.
3. Instructional leadership is positively and significantly related to collective efficacy beliefs through its effect on teacher collaboration.
4. Collective efficacy beliefs are positively and significantly associated with differences among schools in students' fourth-grade mathematics and reading achievement.
5. Both instructional leadership and teacher collaboration are positively and significantly related to student achievement through their effects on collective efficacy beliefs.

Method

This section describes the methods employed to test the main hypotheses. The sample, data collection procedures, measures, and primary analytic method are defined and explained.

Sample

To test the hypotheses described above, we employed data from the first year of the School Leadership Improvement Study, a large-scale, longitudinal, randomized control trial designed to evaluate the implementation and effectiveness of McREL's Balanced Leadership program. It is important to note that this article does not report experimental findings regarding the effectiveness of this professional development program but, instead, makes use of baseline data to test the hypotheses derived above using a quasi-experimental design. The sample for this study comprises 93 elementary schools serving students in rural, high-poverty areas located in the northern regions of a Midwestern

state. The analyses presented here draw from teacher surveys administered to 1,606 teachers as part of the first round of data collection for the study, collected during the 2008–9 school year. Information on the fourth-grade students ($n = 4{,}167$) and 93 schools was drawn from a state accountability data system for school years 2008–9 and 2009–10.

Measures

Restricted-use student-level measures were obtained with the permission and cooperation of a state-authorized data management organization. The student-level measures include current and prior achievement item-response theory scale scores by grade and subject area and student demographic information, including special education enrollment, socioeconomic status measured with free or reduced-price lunch, LEP (limited English proficiency), migrant status, and gender. School-level measures of socioeconomic status, proportion of minority students, and size were drawn from a public-use state accountability information system.

The measures of instructional leadership, teacher collaboration for instructional improvement, and collective efficacy beliefs were based on teacher reports taken from self-administered surveys. The measures of instructional leadership, teacher collaboration, and collective efficacy were developed using an iterative process involving knowledge of prior research, principle components factor analysis, and judgments of theoretical fit. Our measure of instructional leadership is composed of 14 items based on teachers' reports of principals' (1) instructional leadership, (2) monitoring of classroom instruction, and (3) openness to sharing leadership (table 1). Teacher collaboration for instructional improvement was measured by three subscales representing (1) the presence of formal structures supporting teacher collaboration, (2) the frequency with which collaboration related to instruction occurred among staff, and (3) the extent to which teachers work collectively to establish instructional policy (table 2).

Collective efficacy beliefs were measured using a 12-item short form. Half of the items on the short form were designed to tap teachers' perceptions of group competence (GC) and the other half to tap teachers' analysis of the teaching task (TA). The scale thus follows the theoretical synthesis offered by Tschannen-Moran and colleagues (1998) by asking teachers to consider both group competence and the difficulty inherent in the task in assessing the capability of the faculty as a whole to organize and execute the courses of action required to reach student achievement goals. Within each subset of items (GC and TA), half are worded positively (e.g., "teachers can . . .") and half are

TABLE 1

Instructional Leadership Measurement Properties

Instructional Leadership[a]	Factor Loading
The principal at this school is very knowledgeable about effective instructional practices	.86
The principal at this school is very knowledgeable about classroom curricular issues	.86
The principal at this school provides conceptual guidance for the teachers regarding effective classroom practice	.89
The principal at this school is very knowledgeable about effective classroom assessment practices	.87
The principal at this school sets high standards for teaching	.85
The principal at this school sets high standards for student learning	.85
The principal at this school is directly involved in helping teachers address instructional issues in their classrooms	.82
The principal at this school helps me with my instructional practices	.82
The principal at this school pushes teachers to implement what they have learned in professional development	.80
The principal at this school actively monitors the quality of teaching in this school	.86
The principal at this school knows what is going on in my classroom	.83
The principal at this school makes systematic and frequent visits to classrooms	.76
The principal develops a shared vision of what the school could be like	.82
The principal at this school encourages people to express opinions that may be contrary to his/her own	.71

NOTE.—Rating scale is 1–6: strongly disagree to strongly agree.
[a] Cronbach's alpha = .96 (14 items).

worded negatively (e.g., "teachers here cannot …"). The negatively worded items were reverse-coded for analysis with the positive items. See table 3 for collective efficacy items.

Primary Analytic Method

We used multilevel structural equation modeling (SEM) to test the relationships between instructional leadership, teacher collaboration for instructional improvement, collective efficacy beliefs, and differences among schools in students' fourth-grade mathematics and reading achievement. Because our primary outcome variables of student mathematics and reading achievement

TABLE 2

Collaboration Measurement Properties

Type of Collaboration	Factor Loading
Formal collaboration (Cronbach's alpha = .74):	
The principal, teachers, and staff collaborate to make this school run effectively	.66
Collaboration in this school occurs formally (e.g., common planning times, team meetings)	.80
When teachers in this school collaborate, our collaboration time is typically structured; we stick to an agenda and/or we systematically work on a particular goal	.83
The principal at this school participates in instructional planning with teams of teachers	.64
Frequency of collaboration on instruction (Cronbach's alpha = .85):	
This school year, how often have you worked with colleagues to develop materials or activities for particular classes/lessons?	.90
This school year, how often have you worked with colleagues to develop instructional strategies?	.88
This school year, how often have you worked with colleagues to make teaching decisions using student assessment data?	.80
This school year, how often have you worked with colleagues to discuss what helps students learn best?	.75
Teachers' collaboration on instructional policy (Cronbach's alpha = .89):	
Teachers in this school work collectively to plan school improvement	.77
Teachers in this school work collectively to select instructional methods and activities	.82
Teachers in this school work collectively to evaluate curriculum and programs	.89
Teachers in this school work collectively to determine professional development needs and goals	.90
Teachers in this school work collectively to plan professional development activities	.81

NOTE.—For categories "formal collaboration" and "teachers' collaboration on instructional policy," the rating scale is 1–6: strongly disagree to strongly agree. The category "frequency of collaboration on instruction" used a 6-point scale: 1 = not at all, 2 = once or twice a year, 3 = several times this year, 4 = monthly, 5 = weekly, 6 = almost daily.

scores were nested within schools, the multilevel approach we employed avoids the bias associated with the single-level approach, which could underestimate standard errors of parameter estimates leading to Type I error inflation (Hox 2010; Raudenbush and Bryk 2002; Snijders and Bosker 1999). Hierarchical

TABLE 3

Collective Efficacy Measurement Properties

	Factor Loading
Group competence (Cronbach's alpha = .80):	
Teachers in this school are able to get through to the most difficult students	.71
Teachers here are confident they will be able to motivate their students	.71
If a child does not want to learn, teachers here give up	.76
Teachers here do not have the skills needed to produce meaningful student learning	.72
Teachers in this school believe that every child can learn	.72
Teachers in this school do not have the skills to deal with student disciplinary problems	.53
Task difficulty (positive; Cronbach's alpha = .75)	
These students come to school ready to learn	.71
Home life provides so many advantages that students here are bound to learn	.83
The opportunities in this community help ensure that these students will learn	.73
Task difficulty (negative; Cronbach's alpha = .61):	
Students here just are not motivated to learn	.47
Learning is more difficult at this school because students are worried about their safety	.76
Drug and alcohol abuse in the community make learning difficult for students here	.71

NOTE.—Rating scale is 1–6: strongly disagree to strongly agree.

data, such as those used in the current study, require a multilevel modeling approach that properly takes into account data dependency to yield correct standard errors. Another benefit of multilevel modeling includes the incorporation of different level covariates in the model. For example, in this study both student- and school-level covariates were considered in relation to student academic achievement.

SEM is a statistical technique that provides rich descriptive and diagnostic information about model fit, along with the simultaneous statistical execution of confirmatory factor analysis (CFA), linear regression, and path estimates for variables appearing in a covariance or correlation matrix (Bollen 1989; Gefen et al. 2000; Long 1983; Maruyama 1998; Schumacker and Lomax 1996). Moreover, the incorporation of measurement errors in defining a factor allows more accurate estimation of the relations among the variables in the model (Heck and Thomas 2009). Considering these advantages of SEM and the nested characteristics of our data, we selected multilevel SEM as our primary

data analytic method. We employed Muthén and Muthén M*plus* (version 5.2; 2008) for data analysis. The estimation method used for multilevel analysis was maximum likelihood with robust standard errors.

Results

Before proceeding to our full model, we conducted basic descriptive work to confirm assumptions that are needed to develop a valid multilevel SEM. Histograms and scatter plots of the endogenous variables and their relationships with the covariates were examined, and no large departures from normality, outliers, or nonlinear relationships were detected. This data set had no missing information at the school level and relatively few missing student-level data (demographic covariates and 2009 student achievement scale scores). However, student prior math and reading achievement scores had about an 8% missing data rate. Extensive diagnostic analysis showed that student prior achievement scores were not considerably related to any variables in the model ($r < .10$), therefore, missing at random (MAR) was assumed. Under the assumption of MAR, by the default of the M*plus* program, missing cases in prior achievement scores were not included in the primary data analysis. Descriptive statistics for all variables used in the multilevel SEM are reported in table 4; correlations among these variables appear in tables 5 and 6.

Creating the Primary Latent Measures

As an initial step, we employed exploratory factor analysis (EFA) with teacher survey data to construct our measures of instructional leadership, teacher collaboration for instructional improvement, and collective efficacy beliefs. For instructional leadership, EFA supported a single construct. The aggregated factor scores derived from EFA were used in the multilevel SEM as an observed measure of instructional leadership in the school-level portion of the model. For teacher collaboration, three factors consistent with our conceptual model were extracted from EFA: collaboration on instructional policy, frequency of collaboration, and formal collaboration. For collective efficacy, EFA supported a three-factor model composed of group competence, positively worded task analysis, and negatively worded task analysis. The EFA factor loadings and reliability of each measure are presented in tables 1–3.

On the basis of EFA, we constructed the primary latent measures for the multilevel SEM. Because instructional leadership was construed as a single factor, the factor scores of instructional leadership were entered in the multilevel SEM as an observed variable. We decided to use instructional leadership

TABLE 4

Descriptive Statistics of Variables in the Multilevel SEM

Variable	Min	Max	Mean	SD
Within-level variables (n = 4,167):				
Fourth-grade math scores 2009[a]	368	542	429.14	20.13
Third-grade math scores 2008[b]	269	409	331.94	21.97
Fourth-grade reading scores 2009[c]	291	527	437.62	31.21
Third-grade reading scores 2008[d]	246	419	334.53	24.61
FRPL[e]	0	1	.53	.50
Special education[e]	0	1	.12	.32
LEP[e]	0	1	.02	.13
Female[e]	0	1	.48	.50
Migrant status[e]	0	1	.01	.08
Between-level variables (n = 93):				
% minority	.00	74.40	10.98	14.67
% FRPL	14.10	83.30	50.71	14.46
Total enrollment	36.00	1,063.00	303.24	144.58
Collective efficacy:				
Group competence	−1.03	.93	.01	.43
Task analysis (positively worded)	−1.23	1.29	−.02	.55
Task analysis (negatively worded)	−1.36	.79	−.02	.48
Teacher collaboration for instructional improvement:				
Formal collaboration	−1.44	1.14	−.01	.51
Frequency teachers collaborate on instruction	−1.46	1.05	−.02	.41
Teachers' collaboration on instructional policy	−1.36	1.18	.01	.47
Instructional leadership	−1.80	1.06	−.00	.60

NOTE.—SD = standard deviation; FRPL = free or reduced-price lunch; LEP = limited English proficiency.

[a] n = 4,147.

[b] n = 3,830.

[c] n = 4,121.

[d] n = 3,810.

[e] 1 = yes.

as a single observed variable instead of a latent construct in the school-level model because this additional latent variable with 14 observed items increased model complexity over the available school-level sample size (93 schools), considering that even a rough rule of thumb for sample size in SEM is 10:1 (10 observations per variable [Nunnally 1967]). Given the limitation, using factor scores derived from EFA instead of composite scores (sum or mean of the observed items) is expected to take into account measurement errors in the observed scores (Brown 2006). Hence, in the multilevel SEM, two latent measures

TABLE 5

Correlations among Level 1 Variables

Within-Level Variable (n = 4,167)	FRPL	SpEd	LEP	Female	MS	Ninth-Grade Math	Ninth-Grade Reading	Eighth-Grade Math
SpEd	.12*							
LEP	.07*	.02						
Female	.03	−.10*	−.02					
MS	.05*	.01	.46*	−.01				
Fourth- grade math scores 2009	−.24*	−.25*	−.07*	−.01	−.06*			
Fourth-grade reading scores 2009	−.21*	−.27*	−.06*	.07*	−.08*	.61*		
Third-grade math scores 2008	−.24*	−.24*	−.08*	−.08*	−.05*	.73*	.60*	
Third-grade reading scores 2008	−.22*	−.32*	−.07*	.06*	−.08*	.56*	.69*	.61*

NOTE.—SEM = structural equation modeling; FRPL = free or reduced-priced lunch; SpEd = special education; LEP = limited English proficiency; MS = migrant status.

* $p < .05$.

TABLE 6

Correlations among Level 2 Variables

Between-Level Variable (n = 93)	Total Enrollment	% Minority	% FRPL	Group Competence	Task Analysis (+)	Task Analysis (−)	Leadership	Collaboration Instructional Policy	Collaboration Frequency
% minority	−.10								
% FRPL	−.32*	.14							
Group competence	−.03	−.17	−.15						
Task analysis (positively worded)	.10	−.14	−.61*	.41*					
Task analysis (negatively worded)	.12	−.24*	−.61*	.20	.73*				
Leadership	.03	−.08	−.04	.43*	.28*	.08			
Collaboration instructional policy (IP)	.00	.05	−.01	.48*	.21*	.15	.36*		
Collaboration frequency	.25*	.19	−.06	.40*	.12	−.11	.30*	.44*	
Collaboration formal	.05	.01	−.13	.37*	.28*	.20	.67*	.55*	.50*

NOTE.—SEM = structural equation modeling; FRPL = free or reduced-priced lunch.
* $p < .05$.

were created: (1) teacher collaboration for instructional improvement with three indicators—collaboration on instructional policy, frequency of collaboration, and formal collaboration, and (2) collective efficacy with three indicators—group competence, positively worded task analysis, and negatively worded task analysis. The indicators used in the analysis were the aggregated factor scores saved from teacher survey EFA. The CFA models of these two latent measures were integrated in the multilevel SEM as shown in figure 1. The CFA factors are reported in tables 7 and 8. Each indicator loaded fairly high on the corresponding factor with a large R^2 supporting the adequacy of our treatment of both teacher collaboration and collective efficacy as unified latent constructs.

Multilevel SEM

The model displayed in figures 1 and 2 graphically depicts the interrelationships implied by our five research questions, which we tested with multilevel SEM. Notably, our model accounts for the influence of covariates at both the student and school levels. At the student level, special education, subsidized lunch, limited English proficiency, migrant status, gender, and prior achievement scores were entered as predictors of variance in student mathematics and reading achievement. We included percent minority, percent subsidized price lunch, and school size (e.g., total enrollment) as school-level covariates.

The SEM diagnostics showed the comparative fit index (CFI = .98), the Tucker Lewis index (TLI = .97), the root mean square error of approximation (RMSEA = .02), and the standardized root mean square residual ($SRMR_{within}$ = .00, $SRMR_{between}$ = .07) for the math achievement model, and the CFI = .97, TLI = .96, RMSEA = .02, $SRMR_{within}$ = .00, and $SRMR_{between}$ = .09 for the reading achievement model. According to the conventional model fit criteria of a single level SEM (Bentler 1990; Bentler and Bonett 1980; Browne and Cudeck 1993; Marsh and Hocevar 1985), all model fit indices met the criteria of an adequate fit (CFI > .90, TLI > .90, RMSEA < .08, SRMR < .08). Thus, given good fits of both math and reading achievement models, we proceeded with confidence to interpret the multilevel SEM parameter estimates for their substantive meaning in relation to our hypotheses.

At the within level, the major predictor of student academic achievement was prior academic achievement scores (β = .70 and β = .66 for mathematics and reading, respectively; see table 9). In addition, student demographic characteristics including special education status (SES) and free or reduced-price lunch (FRPL) were negatively related to student mathematics and reading achievement. For math, migration status was also negatively associated with student achievement. However, after taking into account prior academic

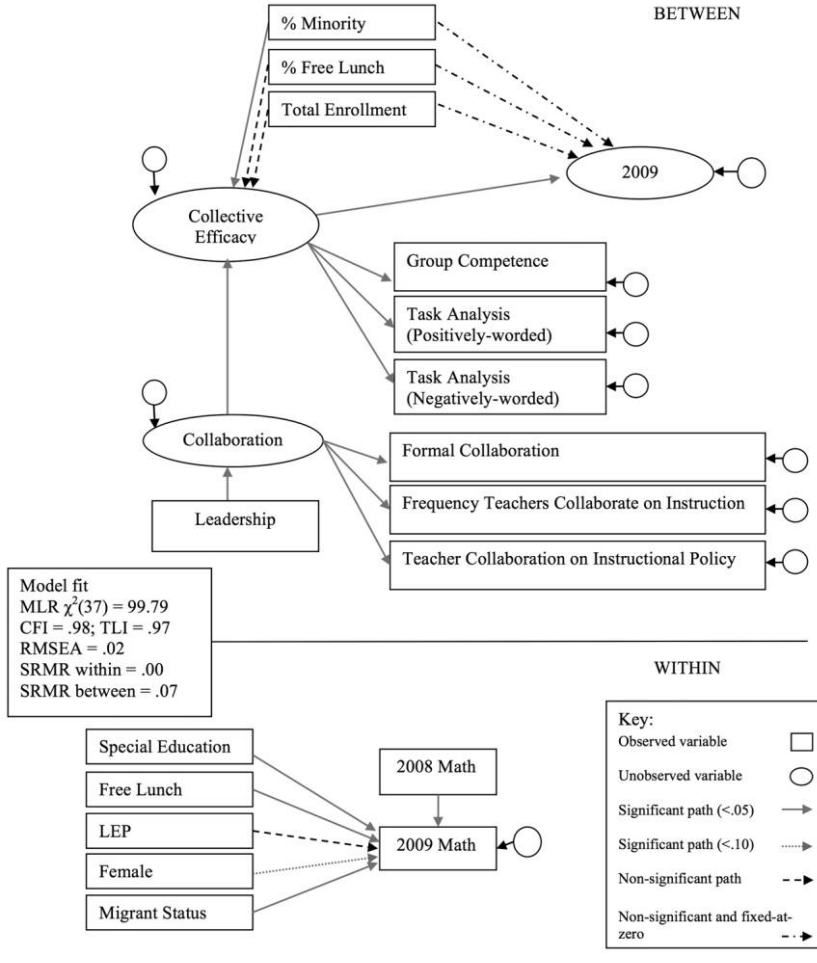

FIG. 1.—Path diagram of multilevel SEM for collaboration, leadership, collective efficacy, and fourth-grade math achievement. Free lunch = free or reduced-price lunch; LEP = limited English proficiency.

achievement, the effects of student demographic covariates on math and reading achievement were considerably smaller.

The between-level (school-level) results of the multilevel SEM for both math and reading achievement largely supported our hypotheses about the interrelationships of collective efficacy, teacher collaboration, and principal leader-

TABLE 7

Collective Efficacy Factor Loadings

	b	SE	β^a	R^2
Math achievement:				
Group competence	1.00	NA***	.40	.16*
Task analysis (positively worded)	2.91	.71***	.90	.82***
Task analysis (negatively worded)	2.24	.75***	.80	.64***
Reading achievement:				
Group competence	1.00	NA***	.41	.17*
Task analysis (positively worded)	2.80	.68***	.90	.82***
Task analysis (negatively worded)	2.15	.69***	.80	.64***

NOTE.—SE = standard error; NA = not applicable.
[a] Equivalent to standardized factor loadings.
* $p < .05$.
*** $p < .001$.

ship, and the effects of these organizational attributes on student achievement. First, instructional leadership was significantly and positively associated with teacher collaboration for instructional improvement ($\beta = .70$; table 9). Second, enactive experience, operationalized as teacher collaboration, was a significant predictor of collective efficacy ($\beta = .27$ for math; $\beta = .28$ for reading). Consistent with theory, collective efficacy was also negatively related to the school level demographic variables (i.e., percent free/reduced-price lunch, percent minority, and school size). However, after controlling for collaboration and school-level SES, percent minority and school size were not statistically significant predictors of collective efficacy. Third, instructional leadership was re-

TABLE 8

Collaboration Factor Loadings

	b	SE	β^a	R^2
Math achievement:				
Teachers collaboration on instructional policy	1.00	NA***	.59	.35***
Frequency teachers collaborate on instruction	.79	.14***	.53	.29***
Formal collaboration	1.72	.39***	.95	.89***
Reading achievement:				
Teachers collaboration on instructional policy	1.00	NA***	.59	.35***
Frequency teachers collaborate on instruction	.79	.14***	.54	.29***
Formal collaboration	1.71	.38***	.94	.89***

NOTE.—SE = standard error; NA = not applicable.
[a] Equivalent to standardized factor loadings.
*** $p < .001$.

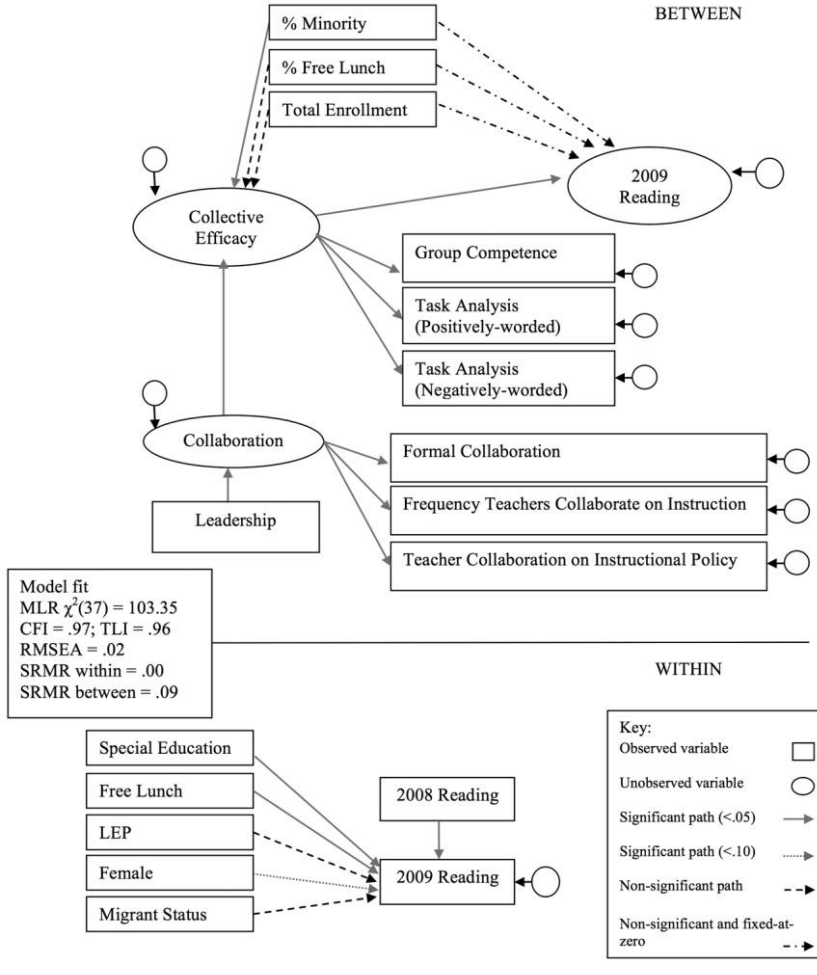

FIG. 2.—Path diagram of multilevel SEM for collaboration, leadership, collective efficacy, and fourth-grade reading achievement. Free lunch = free or reduced-price lunch; LEP = limited English proficiency.

lated indirectly to collective beliefs through teacher collaboration ($\beta = .19$; table 9). Finally, as presented in table 9, collective efficacy was significantly and positively associated with both mathematics ($\beta = .35$) and reading ($\beta = .45$) achievement. The current study also confirms previous research on the mediating effects of school leadership, as instructional leadership was indirectly

TABLE 9

Path Coefficients of Multilevel SEM for Collaboration, Leadership, Collective Efficacy, and Fourth-Grade Math/Reading Achievement

	b	SE	β
Within (n = 3,830):			
2009 math:			
Special education	−5.30	.74	−.09 ***
FRPL	−2.80	.39	−.07 ***
LEP	.44	1.70	.00
Female	.78	.46	.02 +
Migrant status	−3.50	1.73	−.01 *
2008 math	.62	.02	.70 ***
Between (n = 93):			
Collaboration:			
Leadership	.33	.07	.70 ***
Collective efficacy:			
Collaboration	.16	.08	.27 *
% FRPL	−.81	.21	−.70 ***
% minority	−.14	.09	−.12
Total enrollment	−.02	.01	−.15
2009 math:			
Collective efficacy	9.03	3.73	.35 *
Within (n = 3,810):			
2009 reading:			
Special education	−6.20	1.58	−.06 ***
FRPL	−4.04	.77	−.07 ***
LEP	2.22	3.73	.01
Female	1.31	.71	.02 +
Migrant status	−5.74	4.47	−.01
2008 reading	.82	.02	.66 ***
Between (n = 93):			
Collaboration:			
Leadership	.33	.07	.70 ***
Collective efficacy:			
Collaboration	.18	.08	.28 *
% FRPL	−.83	.21	−.69 ***
% minority	−.15	.09	−.13
Total enrollment	−.02	.01	−.14
2009 reading:			
Collective efficacy	9.17	2.84	.45 ***

NOTE.—SE = standard error; FRPL = free or reduced-price lunch; LEP = limited English proficiency; ICC = intraclass correlation. For a fully unconditional model, ICC_{math} = .123, $ICC_{reading}$ = .041. In this table, ICC_{math} = .049, $ICC_{reading}$ = .013.

+ $p < .10$.

* $p < .05$.

*** $p < .001$.

related to math achievement ($\beta = .06$) and to reading achievement ($\beta = .09$) via collaboration and collective efficacy (table 10). Teacher collaboration for instructional improvement also indirectly explained math achievement ($\beta = .09$) and reading achievement ($\beta = .12$) through collective efficacy.

Discussion

The purpose of our study was to test theoretical linkages among principal leadership, teacher collaboration for instructional improvement, collective efficacy beliefs, and student achievement. The results of our study confirm our main hypotheses. First, our results showed that the degree to which teachers collaborate to improve instruction was strongly predicted by principals' instructional leadership. Indeed, the strength of this relationship suggests that schools in which principals were reported by teachers to frequently monitor instruction and to provide relatively strong instructional guidance were the ones most likely to be characterized by high levels of collective work among teachers to improve instruction. In contrast, schools with low levels of instructional leadership were also those with the least frequent formal collaboration around instructional improvement. These results confirm that principal leadership is a necessary condition to develop teacher collaboration and thus to work toward improved student outcomes. The strong interrelationship between principal leadership and teacher collaboration (effect size = .70) is consistent with research that suggests the importance of strong instructional leadership to teachers' collaborative work and school improvement (Wahlstrom and Louis 2008).

TABLE 10

Indirect Effects of Collaboration, Leadership, and Collective Efficacy on Fourth-Grade Math/Reading Achievement

From	To	Effect	SE
Math achievement:			
Leadership	Collective efficacy	.19	.07 **
Leadership	Math achievement	.06	.03 *
Collaboration	Math achievement	.09	.05 *
Reading achievement:			
Leadership	Collective efficacy	.19	.07 **
Leadership	Reading achievement	.09	.04 *
Collaboration	Reading achievement	.12	.06 *

NOTE.—SE = standard error.
* $p < .05$.
** $p < .01$.

The finding that the degree of teacher collaboration likely depends on the strength of instructional leadership characterizing schools is even more important when considering that, as hypothesized, teacher collaboration for instructional improvement was a strong direct predictor of collective efficacy beliefs. Indeed, the results are highly consistent with our contention that school improvement requires strong instructional leadership and sustained work among teachers on teaching and learning.

Our results also confirm that principals' instructional leadership is a significant positive predictor of collective efficacy beliefs through its influence on teachers' collaborative work. These findings not only provide general support for several of the assumptions of social cognitive theory but also suggest that the interrelationships among the sources of efficacy belief-shaping information may be more complex than typically presented or studied. For example, although social cognitive theory suggests enactive experience as a source of information that influences efficacy beliefs, it appears possible that there may be mechanisms of causal order among different forms of enactive experience that theorists should consider to more fully understand how experience influences beliefs. We suggest that the path from instructional leadership to teachers' instructional improvement work is one way to understand key linkages among types of enactive experiences that contribute to collective efficacy beliefs in schools.

Our findings also indicate that, consistent with prior research (Bandura 1993; Goddard et al. 2000, 2004), perceived collective efficacy is a significant positive predictor of differences among schools in student achievement. The more robust the sense of collective efficacy characterizing the schools in our sample, the greater their levels of student achievement, even after controlling for school and student background characteristics and prior levels of student achievement. In addition, the psychometric analyses reported provide strong support for the validity and reliability of scores on the latent measure of teacher collaboration we conceptualized to include teachers' influence over instructional policy, the frequency of collaboration, and the degree to which collaboration is formalized.

Finally, our results demonstrate that both principals' instructional leadership and teacher collaboration for instructional improvement are important indirect predictors of differences among schools in student academic achievement. These findings are not only consistent with extant research (Goddard et al. 2007; Louis et al. 2009; Robinson et al. 2008; Waters et al. 2003) but also add the finding that leadership and collaboration make a difference in part because of their influence on teachers' beliefs.

In sum, all of our hypotheses were confirmed. Thus, our results provide general support for social cognitive theory as well as some new theoretical and practical considerations, including the ways in which different types of enactive experience may matter to collective efficacy beliefs in schools. This work has important implications for researchers and practitioners. Broadly, our results

suggest that by promoting a culture of collaboration around instructional improvement, leaders have the potential to support school improvement in ways that positively influence teachers' collective efficacy beliefs and thus promote student achievement (Hallinger 2003, 2005; Leithwood and Mascall 2008; Louis et al. 2009). Our work importantly supports prior research indicating that principals should set high standards for teaching and learning; be knowledgeable about and seek teacher input regarding instruction, curriculum, and assessment (Hausman and Goldring 2001; Rosenholtz 1989; Smylie 1994; Smylie et al. 1996); spend time in classrooms so that they are aware of instructional practices in their schools (Waters et al. 2003); and empower teachers to work together by creating formal structures aimed at supporting teachers' collaborative efforts to improve instruction and learning (Goddard et al. 2007). Notably, however, our work and much of the previous research we cite here was conducted in elementary schools. Because high schools have different and often more complex organization structures, future researchers may wish to ask how the relationships we tested might differ in high schools, as our results do not generalize to this level.

There is a growing body of evidence to support the link between teacher collaboration and student achievement, but more research is warranted to explore the manner and extent to which teachers' collective work affects student outcomes. However, several specific recommendations are possible based on our measure of teacher collaboration. First, it is important for collaboration to be frequent, formal, and focused on instructional improvement. That is, while everyday collaboration in the lunch room and parking lot are welcome, our results suggest that benefits accrue from formally structured time for teachers to work together on their professional learning for instructional improvement. Such work is necessary, for example, to form common understandings of good student work and to diagnose and respond to student misunderstandings. In addition, given that social cognitive theory specifies the importance of vicarious experience to efficacy beliefs, one of the most powerful forms of intensive teacher collaboration that principals can support is teachers' observations of others' classrooms to form common understandings of good teaching practice. While much more research is needed to understand the relative benefits of within- and cross-school or district observation and under what circumstances, it seems that our results signal a clear need for principals to support sustained interactions around instructional improvement to improve teaching and learning.

Similarly, while research supports the direct connection between collective efficacy and student achievement (Bandura 1993; Goddard 2000, 2001), the manner in which leaders and teachers work together to improve instruction and collective efficacy beliefs deserves more attention. As suggested by our findings, strong instructional leadership is essential to put in place the structures

and processes that support teachers' collaborative instructional improvement. Although we examined instructional leadership and collaboration broadly, we are able to suggest some specific approaches leaders might take to support teachers' collaborative work and make normative changes in their schools that could improve student outcomes. Specifically, we asked teachers to provide input regarding the extent to which their principals were knowledgeable about effective assessment and instructional practices and provided conceptual guidance to teachers regarding these practices; set high standards for teaching and learning; were aware of classroom practices; made systematic and frequent classroom visits; and were directly involved in helping teachers improve their instructional practices. Leaders may thus wish to focus their school improvement efforts on these specific leadership approaches in an effort to foster instructional improvement and build a positive normative environment in their schools. Further, supporting teachers' collective work in school improvement efforts related to selecting and evaluating instructional materials and approaches, as well as professional development efforts, may improve teachers' collective beliefs in their abilities to teach all students successfully. Leaders will need to provide time for teachers to collaborate frequently as well as to support formal structures for teachers' collaborative work. These formal structures may include agendas or goals focused on specific aspects of instructional improvement. Finally, leaders should participate as members of these collaborative teams.

Conclusion

Leaders have tremendous potential to influence the collective work and beliefs of teachers in their schools. As concluded in this study, the work of school leaders toward instructional improvement, through their support of teachers' collective work, affected teachers' reports of collective efficacy beliefs in their schools. Further, teachers' collaborative efforts and their conjoint beliefs in their ability to instruct effectively were associated positively and significantly with student achievement. Such approaches to school improvement deserve considerable attention that differs fundamentally from traditions of isolated and uncoordinated efforts too typical of education research and practice. Theoretically linking school leadership, teacher practice, and organizational belief systems to achievement through social cognitive theory is a step in this direction.

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