

SCHOOL LEADERSHIP AND STUDENT ACHIEVEMENT: THE MEDIATING EFFECTS OF TEACHER BELIEFS

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Principals are held accountable for student achievement although most studies find that they have no direct effect on it. In this study we tested a model hypothesizing that principals contribute to student achievement indirectly through teacher commitment and beliefs about their collective capacity. Path analysis of data from 205 elementary schools supported this hypothesis. Schools with higher levels of transformational leadership had higher collective teacher efficacy, greater teacher commitment to school mission, school community, and school-community partnerships, and higher student achievement. Increasing the transformational leadership practices in schools makes a small but practically important contribution to overall student achievement.

Key words: teacher efficacy, transformational leadership, path analysis, grade 3 and 6

Les directions d'écoles sont imputables au regard du rendement scolaire sur lequel elles n'ont aucun effet direct d'après la plupart des études. Les auteurs ont testé un modèle selon lequel la direction d'école contribuerait indirectement au rendement scolaire à travers l'implication des enseignants et leurs façons de percevoir leur capacité collective. L'analyse acheminatoire (path analysis) de données issues de 205 écoles primaires vient étayer cette hypothèse. Les écoles présentant un niveau plus élevé de leadership transformationnel se distinguaient par une plus grande efficacité du corps enseignant, une implication plus grande des enseignants vis-à-vis de la mission de l'école, de l'équipe-école, des partenariats école-communauté et un meilleur rendement scolaire. L'amélioration d'un écart-type des méthodes propres au leadership transformationnel dans les écoles augmenterait le rendement scolaire en lecture, en écriture et en mathématiques en 3^e et en 6^e années de 0,22 d'un écart type.

Mots clés : efficacité des enseignants, leadership transformationnel, analyse acheminatoire, 3^e et 6^e années

Principals, regardless of the student populations they serve, are held accountable for student achievement in their schools. However, research reviews find that the direct effect of principals on student achievement is near zero (Hallinger & Heck, 1996; Leithwood, Jantzi, & Steinbach, 1999; Witziers, Bosker, & Kruger, 2003). Holding principals accountable may be defensible if a principal can be found to have an indirect influence on achievement by creating the organizational conditions through which improved teaching and learning occurs. For example, Hallinger, Bickman, and Davis (1996) found that principals contributed to reading achievement through the creation of a positive instructional climate (high teacher expectations, student opportunity to learn, clear mission, and grouping for instruction).

In the study reported here, we re-analyzed a previously reported database to test several models linking leadership to student achievement. We focused on the mediating effects of teacher professional commitment and collective teacher efficacy, two powerful sets of variables that have not been previously examined as sources of indirect leadership effects on achievement. We began by constructing what we viewed as our most plausible model (displayed in Figure 1) and then developed several variants of it. Figure 1 proposes that principals influence student achievement by creating capacity in the organization in terms of teacher beliefs in their collective agency and in terms of their commitment to the goals of the organization. In a previous analysis of the database (using a split sample design different than the sample split used in the present study), we demonstrated that principals who adopt transformational leadership behaviours contribute to teachers' professional commitment directly and indirectly through collective teacher efficacy (Ross & Gray, 2006). In the current study we extended the model to examine indirect leadership effects on student achievement, using previous research on leadership, social cognition theory, and school improvement to construct the paths that went into the model.

MODEL

The Paths from Leadership to Teacher Commitment

Transformational leadership was chosen for this study because it is compatible with broadly based trends of teacher empowerment, multiple

stakeholder participation in school decisions, and reduced support for top-down change theories. In addition, substantial evidence exists that transformational leadership is a stronger predictor of teacher beliefs and practices than transactional leadership (e.g., Koh, Steers, & Terborg, 1995). Although often measured as a global trait, transformational leadership is a multidimensional construct that involves three clusters: charisma (identifying and sustaining a vision of the organization), intellectual stimulation of members, and individual consideration (Bass & Avolio, 1994). Transformational leadership enhances an organization by raising the values of members, motivating them to go beyond self-interest to embrace organizational goals, and redefining their needs to align with organizational preferences.

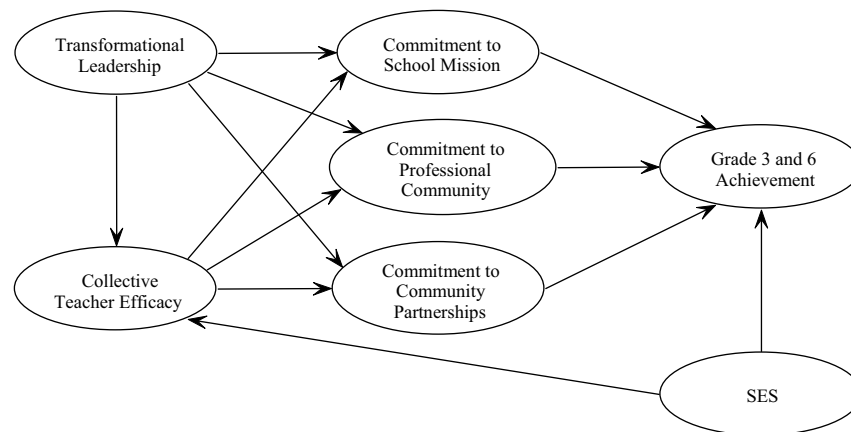


Figure 1. Hypothesized model linking leadership to student achievement through teacher capacity building.

The model predicts that transformational leadership will influence teachers' professional commitment, defined here as commitment to organizational values. Previous research has found that transformational leadership accounts for 17-18 per cent of the variance in organizational commitment (Koh et al., 1995; Nguni, Slegers, & Denessen, 2006). Transformational leadership also contributes to a closely related concept, organizational citizenship, which refers to an individual's willingness to

go beyond the formal requirements of the job to engage in productive functions to enhance organizational effectiveness (Koh et al., 1995; Leithwood, Tomlinson, & Genge, 1996; Nguni et al., 2006; Podsakoff, MacKenzie, Moorman, & Fetter, 1990 but not in Tschannen-Moran, 2003).

In Figure 1 we represented three dimensions of organizational commitment: commitment to school mission, commitment to professional community (i.e., to school norms of collegiality, collaboration, and joint work), and commitment to community-school partnerships. Figure 1 proposes that transformational leadership will contribute to each.

The Path from Transformational Leadership to Collective Teacher Efficacy

In social cognition theory, beliefs about personal agency form the foundation of action. Self-efficacy is the belief “in one’s capabilities to organize and execute the courses of action required to produce given attainments” (Bandura, 1997, p. 2). Self-efficacy affects behavior directly by impacting goals, outcome expectations, affective states, and perceptions of socio-structural impediments and opportunities (Bandura, 2000). Individuals who feel that they will be successful on a given task are more likely to be so because they adopt challenging goals, try harder to achieve them, persist despite setbacks, and develop coping mechanisms for managing their emotional states. Collective teacher efficacy is a specific form of self-efficacy in which the target of the beliefs is the organization to which the individual belongs, i.e., “the perceptions of teachers in a school that the efforts of the faculty as a whole will have a positive effect on students” (Goddard, Hoy, & Hoy, 2000, p. 480).

Transformational leadership might contribute to collective teacher efficacy through each of the four mechanisms identified by Bandura (1986) as sources of efficacy information. The most important is mastery experience, i.e., those who have experienced success, which they attribute to their ability, anticipate similar successes when encountering similar tasks in the future. By setting feasible goals, clarifying standards, and linking actions of teachers to student outcomes, a principal influences teacher self-assessments that contribute to efficacy beliefs. Leadership actions contributing to teacher efficacy include emphasizing accomplishment (Lee, Buck, & Midgely, 1992), giving frequent feedback

(Chester & Beaudin, 1996), and promoting an academic emphasis in the school (Hoy & Woolfolk, 1993). Principals also contribute to efficacy beliefs through persuasion (inspirational messages and affirmations of teacher competence by sharing decision making), vicarious experience (providing opportunities for teachers to observe each other's success), and by reducing teacher stress (e.g., insulating teachers from district prescriptions). Capara, Barbaranelli, Borgogni, and Steca (2003) found that transformational leadership predicted collective teacher efficacy.

The Path from Collective Teacher Efficacy to Commitment

The relationships among teacher efficacy and various dimensions of teacher commitment have been amply demonstrated at the individual level (evidence reviewed in Ross, 1998). Fewer studies have examined the path at the collective level. However, Goddard (2002) found that collective teacher efficacy was associated with teacher influence over school decisions, Somech and Drach-Zahavy (2000) found that collective teacher efficacy influenced teachers' willingness to assist each other, and Jex and Bliesse (1999) found that collective efficacy contributed to higher commitment in a military setting.

The Path from Commitment to Achievement

Teachers who are more committed to the values of an organization and to its members are more likely to adopt instructional practices recommended by the organization, assist colleagues, and work harder to achieve organizational goals. Such commitment would contribute to higher student achievement (as found by Koh et al., 1995; Park, 2004) if school goals were focused on academic achievement, a commitment that is not always the case. However, in the study reported below, schools were required by the province to develop explicit improvement goals based on the results of annual provincially mandated assessments.

The Path from SES to Achievement

The influence of SES on student achievement has been amply demonstrated in school effectiveness research (reviewed in Teddlie & Reynolds, 2000). In Canada, the key SES predictor of student achievement

is family income (Lytton & Pyrt, 1998; Nagy, Traub, & Moore, 1999; Willms, 2002).

The Path from SES to Collective Teacher Efficacy

The strongest contributor to high teacher efficacy is mastery experience, i.e., when teachers recognize they have been successful in the past they anticipate they will be capable of handling similar tasks in the future. Teachers are more likely to be successful when they teach in schools serving advantaged populations. Goddard, LoGerfo, and Hoy (2004) found that schools with high SES had higher collective teacher efficacy.

OTHER PLAUSIBLE MODELS

Research on the complex interplay of leadership, school process, school context, and student achievement has identified other paths that could be tested with our database. After testing the model in Figure 1, we examined three additional paths.

The Path from Transformational Leadership to Student Achievement

Principals typically have stronger effects on school processes than on student achievement but small, statistically significant contributions to achievement, independent of indirect effects through school processes, have been demonstrated (e.g., Marks & Printy, 2003). We regard such evidence as sufficient to warrant testing of the path but the overall null effects of direct effects models inhibited us from including the direct path from leadership to achievement in our original model.

The Path from Collective Teacher Efficacy to Student Achievement

Previous research has found a direct link between collective teacher efficacy and achievement, after controlling for demographic variables like SES, race, urbanicity, and others (Bandura, 1993; Goddard, 2001; Goddard & Goddard, 2001; Goddard et al., 2000; Goddard, Hoy, & Woolfolk Hoy, 2004; Goddard & LoGerfo, 2004). No study has examined whether the path is significant when teacher commitment variables are included. Because we suspected that the effects of collective teacher efficacy on achievement would be entirely mediated by teacher commitment, we did not include this path in our original model.

The Path from Prior Achievement to Collective Teacher Efficacy

The same argument linking SES to collective teacher efficacy can be extended to prior achievement. Teachers in schools with a record of high student success are likely to feel efficacious. Adams and Forsyth (2004) found that more than half of the variance in collective teacher efficacy could be attributed to prior achievement, after controlling for school contextual factors.

METHOD

We invited all elementary teachers in two Ontario districts to participate. Schools were retained if at least five teacher responses were received (N = 205 schools; 3042 teachers). All schools with grade-3 or grade-6 students met the criterion. The smaller district (N = 71 schools with grade-3 or -6 students) covered a large geographic area (7,000 square kilometres). The proportion of students who were identified as English as second language (2%) and who were born outside of Canada (<1%) was lower than in the province as a whole (10% and 12% respectively). In contrast, 21 per cent of grade-3 and -6 students were identified as special needs, compared to 12 per cent in the province. The district had achievement scores and family incomes that were slightly below the provincial averages. The larger school district (N = 134 schools with grade-3 or -6 students) covered a concentrated geographic area (200 square kilometres). The proportion of students who were ESL or born outside of Canada (both 6%) were higher than in the smaller district but still below the provincial averages. Achievement scores and family incomes were higher than provincial averages.

Instruments

Data consisted of teacher responses to Likert items with a 6-point response scale anchored by strongly disagree and strongly agree. All items were taken from previous studies (Goddard et al., 2000; Leithwood, Aitken, & Jantzi, 2001; Rosenholtz, 1989; Ross & Gray, 2006). *Transformational leadership* consisted of 12 items measuring teacher perceptions that their principal leads by developing the capacity of the organization and its members to adapt to the demands of a changing environment. *Collective teacher efficacy* consisted of 14 items developed by

Goddard et al. (2000). Teacher commitment to organizational values consisted of three variables: *Commitment to school mission* consisted of 12 items that measured teachers' acceptance of school goals, their belief that these goals were shared by the staff, and their commitment to reviewing school goals regularly. *Commitment to the school as a professional community* consisted of 5 items representing teachers' commitment to sharing teaching ideas with each other. *Commitment to school-community partnerships* consisted of 4 items measuring teacher commitment to including parents in setting school directions. The adequacy of the commitment variables was tested with confirmatory factor analysis (described in Ross & Gray, 2006). The items used in the study are displayed in the Appendix. Teachers completed the survey in February 2001.

Current student achievement consisted of the mean percentage of students in the school who reached the provincial standard in a mandated assessment, administered in May 2001. The test was a performance assessment conducted over five days (180 minutes per day) in which students responded to open ended tasks (over 80% of the assessment) and completed multiple choice items. The provincial testing organization, Education Quality and Accountability Office (EQAO), reported for each school the percentages of students achieving the provincial standard (level 3 on a 4 point scale) in grades 3 and 6 in reading, writing, and mathematics. EQAO includes a set of protected items as indicators of test difficulty; these items are used to calibrate scores to facilitate year to year comparisons (Education Quality and Accountability Office, 2006). *Prior student achievement* consisted of the mean percentage of students reaching the provincial standard in the previous year (May 2000). We represented *student achievement* in Figure 1 as the residuals from regressing 2001 scores over 2000 scores. Because school improvement scores are unstable for individual years and subjects (Linn & Haug, 2002), we averaged across grades and subjects to compile a composite school score.¹

SES consisted of mean family income of the enumeration area represented by the postal code of the school (obtained from the 1996 national census). Nagy, Traub, and Moore (1999) demonstrated that this proxy for average school family income was comparable and more cost-

effective than tracking the mean income of individual student postal codes.

Analysis

SES data were prepared by replacing missing values with the mean ($N = 8$ of 205). Outliers in raw achievement scores and SES scores were recoded to plus or minus two standard deviations. SES was standardized.

Although our survey data were multi-level (teacher and school), student achievement was reported only at the school level, which meant we could not use hierarchical analysis methods. We tested the model in Figure 1 and elaborations of it using path analysis. The raw data were input to SPSS and the variance-covariance matrix was analysed using the maximum likelihood method of AMOS 4.0 (Arbuckle & Wothke, 1999). To guard against capitalizing on chance, we used a cross-validation strategy by randomly assigning schools within districts to create two groups, consisting of 102 and 103 schools respectively.² We used the first group as the exploration sample to test and refine the model; the second sample was the validation sample in which we replicated the analysis without further model modification. The criteria used for model fit were chi square $<.05$, AGFI (Adjusted Goodness of Fit) $>.90$, and RMSEA (Root Mean Square of Approximation) $<.08$ (Browne & Cudeck, 1993). AGFI was used because it adjusts for sample size (unlike GFI) and RMSEA because it adjusts for number of variables in the model (unlike RMR), following guidelines of Thompson and Daniel (1999).

RESULTS

Table 1 describes the variables. All were reliable (alphas ranged from .85 to .97) and normally distributed (none of the Kolmogorov-Smirnov tests was statistically significant). Table 2 displays the correlation matrix. Student achievement correlated with all variables in the model but one (professional commitment). Leadership also correlated with all but one variable (SES).

Figure 2 displays the results for the base model using the exploration sample. The data were multivariate normal (multivariate kurtosis = .883,

Table 1: Descriptive Statistics for Study Variables (N=205 schools)

Variable	Mean	SD	Alpha	Kolmogorov-Smirnov	
				Z	p
School Family Income (SES)*	52007	12121	-	1.13	.15
Transformational Leadership (TL)	4.90	.46	.97	.84	.48
Collective Teacher Efficacy (CTE)	4.60	.39	.91	1.02	.25
Teacher Commitment to School Mission	4.78	.38	.94	.71	.70
Teacher Commitment to Professional Community	4.74	.45	.91	.82	.52
Teacher Commitment to Community Partnerships	4.65	.51	.85	.99	.28
Achievement Residuals	0.00	1.00	-	1.13	.15
Pretest Score	51.77	13.08	-	.826	.50
Posttest Score	52.64	13.91	-	.653	.79

*before standardization

Table 2: Correlation Matrix of Model Variables (N=205 schools)

	SES	TL	CTE	Mission	Prof Comm	Comm Partner
TL	-.115	-				
CTE	.335**	.455**	-			
Mission	-.069	.844**	.519**	-		
Prof Comm	-.131	.622**	.403**	.643**	-	
Comm Partner	.270**	.436**	.816**	.478**	.381**	-
Achievement	.251**	.172*	.384**	.206**	.070	.357**
Pretest Score	.409**	.024	.560**	.143*	-.047	.502**
Posttest Score	.379**	.140*	.580**	.233*	.025	.524**

* p<.05 (2-tailed); ** p<.01 (2-tailed)

SES = average family income; TL = transformational leadership; CTE = collective teacher efficacy; Mission = teacher commitment to the mission of the school; Prof Comm = teacher commitment to the school as a professional community; Comm Partner = teacher commitment to community partnerships

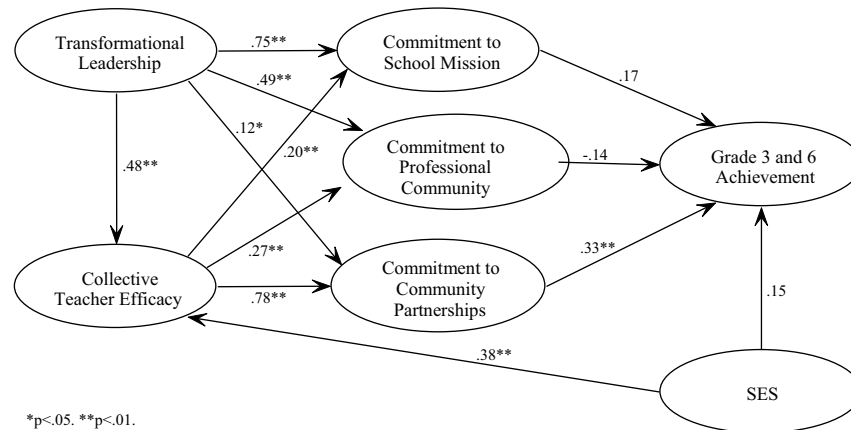


Figure 2. Base model linking leadership to student achievement through teacher capacity building

CR = .399). Each of the three criteria for goodness of fit was met. (Table 3 displays the goodness of fit statistics for the base model and elaborations of the base model, for the exploration and validation samples.) The path statistics shown in Figure 2 are standardized regression weights. We omitted from Figure 2 the error terms for each of the variables for reasons of clarity. Also omitted is the unanalyzed association of disturbances for two of the teacher commitment variables. The residual (unexplained) variances of commitment to school mission and commitment to the school as a professional community were positively correlated ($r = .40$), suggesting that a variable not in the model was affecting both variables. All the other residual variances were independent.

Figure 2 provides support for the indirect effects model of principal contributions to student achievement. The figure shows that principals who adopt transformational leadership styles contribute to higher collective teacher efficacy and to teachers' commitment to the school mission, to the school as a professional community, and to involving the external community in setting school directions. The strongest of these

paths was from leadership to commitment to mission (.749); the weakest was from leadership to commitment to community partnerships (.120). The predicted paths from collective teacher efficacy to three dimensions of teacher commitment were also confirmed, as was the path from SES to collective teacher efficacy. There was less support for the paths to achievement. The path from teacher community partnerships commitment to student achievement was statistically significant but the paths from other teacher commitment variables were not. The results support the view that principal effects on achievement occur through leadership contributions to teachers' perceptions of their capacities: collective teacher efficacy and teacher commitment to professional values. The indirect effect of leadership on achievement was small: for every 1.0 standard deviation increase in transformational leadership there was a .222 standard deviation increase in student achievement. The model explained only 17 per cent of the variance in school achievement.

Table 3: Goodness of Fit Statistics for Models Tested

Sample	Models	Chi-square	AGFI	RMSEA
Exploration	Base	$\chi(8)= 9.079$, p=.336	.915	.036
Exploration	Base + TL → achievement	$\chi(7)= 8.612$, p=.282	.908	.048
Exploration	Base + CTE → achievement	$\chi(7)= 6.773$, p=.453	.982	.000
Exploration	Base + SES →CTE	$\chi(12)= 15.015$, p=.241	.891	.050
Validation	Base	$\chi(8)= 11.294$, p=.186	.898	.024
Validation	Base + TL → achievement	$\chi(7)= 11.087$, p=.135	.886	.076
Validation	Base + CTE → achievement	$\chi(7)= 9.896$, p=.195	.899	.064
Validation	Base + SES →CTE	$\chi(12)= 30.577$, p=.002	.813	.124

SES = average family income; TL = transformational leadership; CTE = collective teacher efficacy

We examined three plausible elaborations of our base model. The

first was to add a direct path from leadership to achievement to replicate the findings of studies that found direct leadership effects. Table 3 shows that fit statistics were acceptable but the path from leadership to achievement was not statistically significant (standardized regression weight = .113, $p = .502$). In the first elaboration of the base model, student achievement effects of leadership continued to be indirect.

In our second elaboration, we added to the base model a path from collective teacher efficacy to achievement. Fit statistics were again acceptable, slightly better than the base model, but none of the paths to achievement, including the path from collective teacher efficacy (standardized regression weight = .270, $p = .122$), was statistically significant. This result suggests that the effect of collective teacher efficacy on achievement reported in previous studies is mediated by teacher commitment to professional values.³

In our third elaboration, we reconfigured our achievement variable. Instead of representing achievement as the residual from regressing current achievement over prior achievement, we included each variable separately. Achievement in Figure 1 became current achievement (i.e., grade-3 and -6 achievement for 2001). We added two paths: from SES to prior achievement (i.e., grade-3 and -6 achievement for 2000) and from prior achievement (2000) to current achievement (2001). The eight variables in the model were normally distributed (multivariate kurtosis = .365, CR = .146). The fit statistics were adequate on two of the three criteria, falling slightly below (.891) the .90 required for AGFI. The new paths were all statistically significant. The standardized regression weight for the path from SES to prior achievement was .428 ($p < .001$) and from SES to current achievement was .428 ($p < .001$). The paths that were statistically significant in the base model continued to be so. The standardized regression weights were virtually identical with two exceptions. Treating prior achievement and current achievement as separate variables increased the strength of the path from SES to collective teacher efficacy (regression weight = .424, $p < .001$) and increased the strength of the path from teacher commitment to community partnerships and student achievement. However, the indirect effects of leadership on achievement declined to ES = .166 from .222.

Our final step was to re-examine the fit of the models in the validation sample, as shown in Table 3. We found that all the models fared less well, indicating they had capitalized on chance to some degree. For the base model, the direct effects of leadership on achievement were slightly lower (total regression weight = .165 compared to .222), mainly because the path from leadership to commitment to community partnerships was no longer significant. The path from leadership to commitment to the school as a professional community was stronger, while the path from collective teacher efficacy to professional community was weaker. All other paths in the base model were virtually identical in the validation sample as they were for the exploration sample. The results of the validation sample confirmed that the effects of leadership on student achievement were mediated by collective teacher efficacy and teacher commitment variables.

The validation sample also confirmed the results for the first and second elaborations. Both models met two of the three criteria for good fit but were slightly deficient on the third. As in the exploration sample, the path from leadership to achievement was not significant, nor was the path from collective teacher efficacy to achievement.

The third elaboration of the basic model was not a good fit of the data in the validation sample, failing all three tests. Finally, we re-ran all the analyses separately for each grade (3 and 6) and subject (mathematics, reading and writing). These six analyses (reported in Gray, 2003) produced no new findings.

DISCUSSION

Contribution of the Study

In this study, we found no statistically significant direct effect of leadership on achievement, as expected from previous research. The substantive contribution of our study is that it has demonstrated that teacher beliefs about their capacity and their professional commitment mediated the impact of principals on student achievement. Although previous studies have identified variables that account for the indirect effects of leadership on achievement, none examined the effect of the teacher belief variables that we considered. Our results indicate that principals who adopt a transformational leadership style are likely to

have a positive impact on teacher beliefs about their collective capacity and on teacher commitment to organizational values. Principals can expect that these teacher beliefs will make a modest but significant contribution to enhanced student achievement. Increasing the transformational leadership practices in schools by one standard deviation would increase student achievement in grade-3 and -6 reading, writing, and mathematics by .22 standard deviations.

We found that the strongest impact on achievement occurred through teacher commitment to school-community partnerships, confirming recent evidence about positive effects of such linkages in elementary (Taylor & Pearson, 2004) and secondary schools (Jeynes, 2004). Our contribution is the finding that principals' influence on teacher willingness to engage in community partnerships occurred through collective teacher efficacy, rather than through attempts to influence teachers' community commitment directly. We interpret this to mean that teachers who believe that they constitute an effective instructional team are more likely to take responsibility for school outcomes than to attribute school failure to parent influences (an obstacle reported by Bryk and Schneider, 2002) and are less likely to fear pressure from middle class parents (Fullan, 2005).

Our findings strengthen the claim for indirect leadership effects in the review by Hallinger and Heck (1996). Of the 15 "state of the art" studies examining indirect leadership that they reviewed, only one (a) focused on student achievement (as opposed to other dependent measures such as "school effectiveness" and "teacher perceptions of school effectiveness"), (b) used sophisticated analytic tools such as Structural Equation Modeling, and (c) included at least 100 schools. Our study met all three criteria.

Our study avoided many of the problems afflicting leadership research, including common method variance (our model was tested with data from different sources: surveys, mandated student assessments, and national census data), over-reliance on modification indices without theoretical justification, and sample dependent models (i.e., developing and testing a model with the same sample, a problem we avoided by using a split-sample design). Our decision to use residuals rather than separating prior and current achievement may be

controversial. However, in our third elaboration of the base model, we entered 2000 and 2001 achievement as separate variables. The result was virtually the same as for our base model, although the total effects of leadership on achievement declined slightly.

The methodological contribution of the study is the demonstration of the need for a cross-validation procedure. The goodness of fit statistics were slightly poorer for all models in the validation sample, indicating there was some capitalization on sample dependent features of the exploration sample database. This was the case, although we used modification indices for only one set of correlated error terms (discussed below).

Implications for Practice

We began this study with the observation that it may be defensible to hold principals accountable for student achievement if it can be demonstrated that principals influence achievement indirectly by creating the organizational conditions through which improved teaching and learning occur. This study provided evidence that principals have such influence through their effect on teacher commitment and collective teacher efficacy. The leadership literature describes specific transformational strategies that enable principals to strengthen teacher commitment. For example, principals who flatten hierarchy and give teachers opportunities to participate in developing school goals and improvement plans obtain higher commitment (Leithwood et al., 1999).

Fewer strategies have been identified for building teacher beliefs in their instructional capacity (i.e., individual and collective teacher efficacy). The most important way in which principals do this is by diagnosing specific instructional needs and arranging for teacher access to suitable professional learning opportunities. Ross and Bruce (in press) suggested that teacher efficacy could also be influenced through teacher self-assessment. Ross and Bruce argued that teachers develop expectations about their future performance by reflecting upon past effectiveness. This private process can be influenced by peers (as demonstrated in Ross and Bruce) and by principals. For example, principals can influence teacher interpretations of their impact on students by defining what constitutes success. Because principals typically have experienced a wider variety of

school settings than their teachers and have legitimate authority, principals are well-placed to set feasible goals and interpret achievement data as evidence of success and failure to meet these goals. Principals also identify exemplars of successful team performance and make it easier, for example through timetabling, for teachers to observe each other, thereby providing opportunities to strengthen collective teacher efficacy through vicarious experience. Principals can persuade teachers that they can become an effective organization, for example, through personnel supervision and staff development processes. Equally important is the potential role of the principal in reducing teacher stress. Our study suggests that principals who engage in such strategies are likely to obtain higher student achievement, as well as a staff that is more confident, more ambitious, and more persistent.

Limitations of the Study

First, cross-validation requires a large sample. There is no accepted convention that prescribes the appropriate ratio of cases to variables in SEM. Stevens (1996) suggested that at least 15 cases per measured variable are required. We met this criterion for the original sample (205 cases and 7 variables) and the two splits. Bentler and Chou (1987) recommended at least five cases per parameter estimate (including error terms as well as path coefficients). Our base model had 27 parameter estimates (12 regression weights, one covariance, seven variances, and seven multiple correlations). We met the Bentler and Chou criterion for the total sample (i.e., 7.6 cases per parameter estimate) but not for the splits.

Second, we correlated the residuals of two of the professional commitment variables, suggesting that these variables (commitment to school mission and commitment to the school as a professional community) were influenced by a variable not included in our model. A likely candidate is suggested by Goddard et al. (2004). They argued that the effect of collective teacher efficacy on teacher commitment is mediated by teacher sense of self-efficacy (i.e., individual teacher beliefs that they are able to bring about student learning). Our failure to measure teacher beliefs about their capacity at both the individual and collective levels may explain the correlated error terms. Another

potential mediator is teacher beliefs about teaching and learning which Barnett and McCormick (2004) found to be correlated with transformational leadership.

Third, we accounted for a relatively small proportion of the between-school variance in achievement (17%). The most likely explanation is that we failed to include a measure of instructional practice.

Directions for Future Research

Our model provides empirical support for holding principals accountable for student achievement in their schools. It also provides a framework based on social cognitive theory that identifies plausible mechanisms for each of the paths in the model and proximate goals for enhancing student achievement, i.e., strengthen teachers' beliefs in their collective capacity and their professional commitment through transformational leadership strategies. The same model might also demonstrate the indirect effects on achievement of principals who adopt an instructional leadership style, i.e., an approach to leadership that focuses on curriculum-specific principal actions such as teacher hiring and assignment, interpretation of curriculum standards, textbook selection, provision of professional development, and supervision of instructional practices. However, teachers' instructional practice would need to be added to the model, most likely as a mediator of the effect of professional commitment on student achievement. For example, previous research (reviewed in Ross, McDougall, & Hogaboam-Gray, 2002) demonstrates that standards-based mathematics teaching (e.g., represented by National Council of Teachers of Mathematics, 2000) makes a greater contribution to student achievement than transmission teaching of algorithms. The model might hypothesize that commitment to mission and to the school as a professional community would contribute to mathematics achievement in schools that had adopted standards-based teaching. The appropriate achievement measure would be a subject-specific instrument rather than the composite scale used in the present study. Testing this instructional leadership version of the model against the transformational leadership version tested in our study would connect the debate about direct and indirect effects of

leadership on achievement to the practical issues of what principals should do to enhance achievement in their schools.

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NOTES

¹ A weighted combined achievement variable was constructed by averaging the values of the grade-3 residuals (mathematics, reading and writing) and multiplying by the number of grade-3 students in the school; averaging the values of the grade-six residuals (mathematics, reading and writing) and multiplying by the number of grade-6 students in the school; adding the results together; and dividing the result by the total number of grade-three and -six students in the school.

² The two random samples drawn for this analysis were not the same random samples used in Ross and Gray (2006) to investigate a similar set of research questions involving the relationships among leadership and school processes. That study did not include student achievement or SES data.

³ We also examined, for the sake of completeness, an elaboration of our base model in which paths were drawn from leadership to achievement and from collective teacher efficacy to achievement. The fit of the model was adequate [chi-square (6) = 6.162, $p = .405$; AGFI = .922; RMSEA = .016] but neither path was statistically significant.

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*APPENDIX**Items in the Study:**Transformational Leadership*

- *1. Leaders in this school do not set a respectful tone for interaction with students.
- *2. Leaders in this school are unwilling to change own practices in light of new understandings.
3. Leaders in this school model problem solving techniques I can readily adapt for my work.
4. Leaders in this school promote an atmosphere of caring and trust among staff.
- *5. Leaders in this school fail to symbolize success and accomplishment within our profession.
- *6. Leaders in this school are not aware of my unique needs and expertise.
7. Leaders in this school provide moral support by making me feel appreciated for my contribution.
- *8. Leaders in this school do not stimulate me to think about what I am doing for my students.
- *9. Leaders in this school do not encourage me to pursue my own goals for professional learning.
10. Leaders in this school encourage us to evaluate our practices and refine them as needed.
11. Leaders in this school encourage me to try new practices consistent with my own interests.
- *12. Leaders in this school do not have high expectations for us as professionals.

Collective Teacher Efficacy

13. If a child doesn't learn something the first time, teachers will try another way.
14. Teachers in this school really believe every child can learn.
- *15. If a child doesn't want to learn, teachers here give up.
- *16. Teachers here need more training to know how to deal with these students.
- *17. Teachers here don't have the skills needed to produce meaningful student learning.
- *18. Teachers here fail to reach some students because of poor teaching methods.
19. These students come to school ready to learn.
20. Home life provides so many advantages they are bound to learn.
- *21. Students here just aren't motivated to learn.
22. The opportunities in this community help ensure that these students will learn.
23. Teachers here are well-prepared to teach the subjects they are assigned to teach.
24. Teachers in this school are skilled in various methods of teaching.
- *25. Learning is more difficult at this school because students are worried about their safety.

- *26. Drug and alcohol abuse in the community make learning difficult for students here.

Teacher Commitment to School Mission

27. Our school goal(s) and priorities encourage improvement of programs.
*28. In our school we rarely review our school goal(s) and priorities.
29. School goals have little influence on my curriculum decisions.
*30. I am uncertain what our school's priorities are.
31. We work toward consensus in determining which initiatives can be implemented.
*32. I am not involved in school decision-making as much as I would like.
33. Teachers in this school have the information they need to participate in school decision-making.
34. In our school we regularly review and, if necessary, revise our school goals and priorities.
35. We focus our school improvement efforts on manageable changes.
36. We are encouraged to develop action plans for improving our own professional growth.
*37. Our school introduces new programs without a clear implementation plan.
*38. Our school does not have a way of monitoring achievement of our school goal(s).

Teacher Commitment to School as a Professional Learning Community

38. We all help new teachers learn what is expected of teachers in this school.
39. There is an atmosphere of caring and trust among staff at this school.
40. Teachers here are willing to share ideas and materials with their colleagues.
41. If I am learning a new teaching technique I can get help in this school.
42. Other teachers in this school encourage me to try out new ideas.

Teacher Commitment to School-community Partnerships

43. The community served by this school is very supportive of our school.
44. Parents/guardians are influential decision-makers in our school.
*45. Our school rarely works directly with parents to improve the educational climate in students' homes.
*46. Our school has difficulty maintaining clear, two-way communication between school and parents/community.

*reverse coded items