ABSTRACT

Title of Thesis: THE INFLUENCES OF CLASSROOM
CHARACTERISTICS AND TEACHER-STUDENT
RELATIONS ON STUDENT ACADEMIC
ACHIEVEMENT

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This study examines close teacher-student relations, classroom

characteristics, and interaction effects on student academic grades and

standardizes achievement scores. Classroom characteristics including teacher

instructional practices, class mean teacher-student relationships, and a classroom

index of academic risk are evaluated for their influence on student achievement.

The participants are 24,328 students (kindergarten through fifth grade) nested

within 946 classrooms from 45 public schools in Virginia. Multilevel analysis

tests the student- and classroom-level associations separately for each grade level.

Results indicate that close teacher-student relations and teacher self-reported use

of good instructional practices predicts positive student academic achievement.

Interaction results indicate that the association between close teacher-student

relations and student achievement is slightly stronger in classrooms with more

academic risk, according to the models examined.

THE INFLUENCES OF CLASSROOM CHARACTERISTICS AND
TEACHER-STUDENT RELATIONS ON STUDENT ACADEMIC
ACHIEVEMENT

By

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Chapter 1

Introduction

Classroom social environment plays an important role in development for school-aged children. Student experiences within the classroom help to develop their behavioral, social, and academic skills. The quality of the interactions that students have with their teachers predicts later academic success (Pianta, Steinberg, & Rollins, 1995). Classroom characteristics, such as class composition, student and teacher characteristics, student interactions with peers and teachers, classroom values, and classroom beliefs all influence student academic development (Pianta, LaParo, Payne, Cox, & Bradley, 2002; Burchinal, Peisne-Feinberg, Pianta, & Howes, 2002; Koth, Bradshaw, & Leaf, 2008; Montague & Rinaldi, 2001; Wright, Giammarino, & Parad, 1986; Perry, Donohue, & Weinstein, 2007; Hamre & Pianta, 2001; Lopaz, 1995; Caprara, Barbaranelli, Steca, & Malone, 2006). Because these components may influence student academic futures, it is important to understand the classroom pathways that underlie student academic achievement.

Teacher-Student Relationship and Academic Performance

Pianta's (1995) teacher-student relationship theory posits that teachers shape student experiences in school. Beyond the traditional role of teaching academic skills, teachers regulate student activity level, teach communication skills, provide opportunities for students to form peer relations, provide behavioral support, and teach coping skills. Teachers have multiple roles and spend a large amount of time with students. Pianta's theory proposes that when

teachers have close and positive relationships with students, they are more motivated to spend extra time and energy promoting student success. But when teachers have conflictual and negative relationships with students, they more frequently attempt to control student behavior and thus hinder efforts to promote a positive school environment for them (Pianta et al., 1995; Hamre & Pianta, 2001). Furthermore, Hamre and Pianta (2001) speculated that students react to their relationships with their teachers. When students perceive that they have close and positive relations with teachers, they are more inclined to trust and like those teachers and thus are more motivated to succeed. In contrast, when students perceive that they have conflictual and negative relationships with teachers, they do not like or trust the teachers, are not motivated to succeed and may be defiant towards the teachers (Pianta et al, 1995; Hamre & Pianta, 2001).

Many studies have reported that the quality of the relations between teachers and students was associated with student academic performance. Birch and Ladd (1997) found that kindergarten students who had a close and positive relationship with teachers performed better on the Metropolitan Readiness Tests (MRT), which measured the students' letter recognition, visual matching, school language and listening and quantitative language skills. Burchinal et al. (2002) examined preschool through second grade students and found that the correlation between close relationships and higher language skills occurred only for African-American children and only for children with authoritarian parents. Hamre and Pianta (2001) examined the influences of conflictual and negative teacher-student relations on kindergarteners' achievement. Hamre and Pianta (2001) found that

students with negative teacher relationships at kindergarten received lower math and language grades and received lower achievement test scores as measured by the Iowa Test of Basic Skills (ITBS) eight years later. Another study examined the influences of negative teacher-student relationship on academic performance among a sample of high school students and found that negative student-teacher relationships were associated with higher school dropout rates for students in the eighth through twelfth grade (Lan & Lanthier 2003).

Overall, multiple studies (Birch & Ladd, 1997; Burchinal et al., 2002; Hamre & Pianta, 2001; Lan & Lanthier, 2003) suggested that the quality of the relationships between teachers and students influenced student academic performance. The specific associations have not been consistent across studies, however. Some studies reported statistically significant positive associations between close teacher-student relations and academic performance, but no significantly negative associations between conflictual teacher-student relations and academic performance (Birch & Ladd, 1997; Burchinal et al., 2002). Other studies reported statistically significant negative associations between conflictual teacher-student relations with academic performances, but no significantly positive associations between close teacher-student relations and academic performance (Hamre & Pianta, 2001; Lan & Lanthier, 2003).

The association between the teacher-student relations and student academic performance is complex, and may differ across students and classrooms characteristics. First, the influence of the teacher-student relations on student academic performance may vary across grade levels. Generally, students in later

grades are beginning to value peer interactions and relations more. Lynch and Cicchetti (1997) found that older students have more positive perceptions of their peer relations than of their relations with parents or teachers. The effects of the teacher-student relations on academic performance found in younger students may be different for older students.

Second, the effects of teacher-student relations on student academic performance may vary as a function of classroom characteristics. Students are developmentally influenced by their ecological context, and classrooms are the primary context in which students develop at school. Students spend a large amount of time interacting within classrooms; hence, the microsystem (i.e., classroom interactions) is instrumental to their academic development (Bronfenbrenner, 1979). However, the examination of whether classroom context moderates the association between teacher-student relationship and student achievement has yet to be explored.

Classroom Characteristics and Academic Performance

Researchers have examined the influences of an array of classroom characteristics on student academic performance. Classroom proportion of students with behavioral problems, teacher beliefs, teacher instructional practices, and classroom interactions between teachers and students have been positively associated with student academic success (Perry, Donohue, & Weinstein, 2007; Koth et al., 2008; Caprara, Barbaranelli, Steca, & Malone, 2006; Meyer, Waldrop, Hastings, & Linn, 1993; Pianta et al., 2002; Mashburn, Pianta, Hamre, Downer, Barbarin, Bryant, Burchinal, Early, & Howes, 2008).

Some researchers have examined how interactions and behaviors between teachers and students in classrooms influenced student academic performance (Montague & Rinaldi, 2001; Koth et al., 2008; Wright, Giammarino, & Parad, 1986; Perry et al., 2007; Hamre & Pianta, 2001). Specifically, Perry et al. (2007) examined the effect of average classroom positive relations on first grade achievement. Using classroom as the unit of analysis, Perry et al. found that in classrooms where teachers exhibited more emotional and positive support for the students, students achieved higher academic gains on a curriculum-based math test and a higher percentage of students met end-of-year math and reading standards. In a second study, Koth et al. (2008) examined the concentration of students with behavior problems in fifth grade classrooms. They found that a higher percentage of disruptive students in a class were negatively associated with student achievement motivation. Results suggested that the clustering of aggressive behavioral students within a classroom may have changed the classroom norm, such that the large number of disruptive peers may have negatively influenced the individual student's academic perception (Koth et al., 2008; Wright et al., 1986).

Other researchers used teacher beliefs and practices to predict student academic performance (Caprara et al., 2006; Pianta et al., 2002). Specifically, Caprara et al. (2006) examined the influence of 2,184 teachers' sense of efficacy on junior high school students within the Italian educational system. Using schools as their unit of analysis, they aggregated teacher sense of efficacy and student grades to the school level to conduct their analysis. The authors found

that schools with higher levels of teacher efficacy had significantly higher student achievement. Results from this study should be viewed cautiously, as the multilevel nature of the data was ignored during the analysis.   Nevertheless, the results provided support for Bandura's social-cognitive theory positing that teachers with strong sense of efficacy beliefs are more motivated and confident in their ability to teach their students, and in turn, are more able to enhance student achievement (Bandura, 2001; Midgley, Feldlaufer, & Eccles, 1989). In a second study, Meyer et al. (1993) investigated the effects of teacher instructional practices on kindergarten student reading performance. They found that teacher practices predicted student reading scores. Better practices consisted of instructional conversations between teacher and students on decoding, comprehension, reading, more time spent on reading activities and providing confirming feedback. A third study found significant correlations between teacher instructional practices and kindergarten student achievement. Specifically, Pianta et al. (2002) found that high ratings on teacher literacy instruction, evaluative feedback and instructional conversations predicted higher student literacy and math achievement scores. Extending beyond elementary grade levels, Lee and Smith (1996) examined the influences of teacher work responsibilities on the academic gains of eighth through tenth grade students. Authors found that teachers with collective responsibility for student academic success and teachers with cooperation among staff obtained higher achievement gains.

Finally, there are some researchers who used a broader combination of classroom relations, interactions and teacher characteristics as classroom characteristics to predict student academic performance. Specifically, Koth et al. (2008) investigated the effects of classroom characteristics on the achievement motivation of 2,468 fifth grade students from 37 schools. They included classroom concentration of students exhibiting behavior problems, teacher education level, and years of experience at school in their investigation of classroom characteristics. Results indicated that classrooms with a high concentration of behavior problems had less order, discipline and achievement motivation of the students. In this study, teacher education level and years of experience at school were not related to student achievement motivation, however. A second study investigated the effects of classroom characteristics on the development of academic, language and social skills among 2,439 pre-kindergarten students from 671 classrooms (Mashburn et al., 2008). Mashburn et al. (2008) examined the influence of teacher education, teacher training, emotional support reflecting positive/negative climate and instructional support reflecting concept development and quality of feedback on student academic development. Only classroom instructional support was positively associated with all five measures of academic and language development.

Previous studies that have examined the classroom characteristics that predict student academic success have identified a number of characteristics that may be productive of student achievement. Results across studies do not always converge, however. Therefore, the present study examines the relation of student

achievement with classroom characteristics, including the classroom mean

closeness of teacher-student relation, teacher instructional practices, and

classroom mean of academic risk.

Limitations of Prior Research

Although many studies reported an association between the quality of

teacher-student relations, classroom characteristics and student academic

performance, several factors limit the degree to which confident conclusions can

be drawn from the prior results. First, small and convenient samples were utilized

for these studies; most studies examined only kindergarten or a single grade level.

The studies rarely examined a range of grades to see whether results are similar

across elementary grades. This limits generalizability of results across the grades.

Secondly, some results reported were correlation or regression analyses without

adequate statistical controls that were not suited to provide a basis for causal

inferences. Specifically, alternative explanations such as prior achievement and

demographic characteristics may have led to the observed results. The authors

were not able to conclude whether the predictor variables produced an increment

in student academic development because the authors did not consider the

influences of the participants' demographic characteristics or prior education

(Birch & Ladd, 1997; Perry et. al., 2007; Lynch & Cicchetti, 1997). Thirdly,

despite much research implying that classroom characteristics influence student

performance, studies have not examined the interaction between classroom

context and teacher-student relation and how that may affect student performance.

Finally, most studies did not adopt a multi-level perspective (i.e., student-level

and classroom-level effects on student academic performance). The studies either analyzed the effects of teacher-student relations on student academic performance without considering how classroom characteristics may have interacted with those results (Hughes & Kwok, 2007; Baker, Grant, & Morlock, 2008) or analyzed the effects of classroom characteristics on class average academic performance without considering how individual student differences may have interacted with the results (Caprara et al., 2006). The associations may have varied between classrooms or within students. Using single-level methods to analyze multilevel data may lead to misleading conclusions due to aggregation bias, misestimation of standard errors, systematic underestimation of group effects, and heterogeneity of regression slopes (Bidwell & Kasarda, 1980).

Overview of the Current Study

The purposes of this study are to examine the influences teacher-student relations and classroom characteristics on student academic achievement. Furthermore, this study examines the cross-level interaction effects of classroom characteristics—specifically class mean of close teacher-student relations, class mean of academic risk, and teacher instructional practices, and teacher-student relations—with student individual characteristics on student academic achievement. A second purpose of this study is to examine whether the associations between classroom characteristics, teacher-student relations and student academic achievement are different depending on student grade levels. A multi-level examination of student-level and classroom-level effects will be conducted. I hypothesize the following:

1. Better teacher-student relations will lead to higher student academic achievement.

2. Student achievement will be enhanced when the classroom mean closeness of teacher-student relations is higher, teachers report using good instructional practices is higher, and classrooms have low academic risk.

3. The influences of teacher-student relations and student academic achievement will vary as a function of classroom characteristics. Specifically, the higher the classroom mean closeness of teacher-student relations, higher teacher report of using good instructional practices, and lower class academic risk, the stronger the relationship between teacher-student relations and student academic achievement.

4. The influences of teacher-student relations and classroom characteristics on student academic achievement will vary as a function of student grade level. Specifically, the individual close relationship between teacher and student matters more for younger grade levels. Whereas, classroom characteristics (i.e., high classroom mean closeness of teacher-student relations, high class academic risk, and high teacher report of using good instructional practices) matter more for upper elementary grade levels.

Conceptual Model for Examining the Associations between Teacher-Student Relations, Classroom Characteristics and Student Academic Achievement

The conceptual model for examining the associations between teacher-student relations, classroom characteristics and student academic achievement is displayed in Figure 1. The conceptual model incorporates the hypothesized

influences on student academic achievement. The conceptual model is also a

guide for the analysis. For simplicity, the Figure 1 model omits possible grade-

level variation in relationships.

Chapter 2

Method

Participants

Data for this study were collected as part of a large-scale experimental investigation of the effectiveness of the Instructional Consultation Teams (IC Teams) intervention (Rosenfield & Gottfredson, 2004). The current study includes data from the baseline year (i.e., 2005-06) and one year following the implementation of the IC Teams intervention (i.e., 2006-07). No significant intervention effects were found on student academic grades (Vu & Bruckman, 2008) or standardized achievement scores for school year 2006-07 (Bruckman & Vu, 2008). The participants consist of 45 suburban public schools in Prince William County, Virginia, and the 24,328 kindergarten through fifth-grade students nested within 946 teachers' classrooms. Participant characteristics are detailed in Table 1.

Procedures

Student and teacher demographic characteristics were provided by the Prince Williams County Public Schools (PWCS) program evaluation office. The data consist of gender, ethnicity, special education classification, English Speakers of Other Language (ESOL) classification, free and/or reduced meals (FARM) classification, grade level placement, student academic grades and standardized achievement scores.

All teachers in the participating schools were asked by the district to complete a Teacher Report on Student Behavior (TRSB), and the University of

Maryland research group asked teachers to complete a Teacher Self Report

(TSR). General education classroom teachers responsible for teaching four or

more students are included in the present study. Each student is uniquely linked

to one teacher. The TRSB survey was administered at schools using the PWCS

intranet. Teachers were provided time and computer access to complete the

survey. Response rates for the TRSB survey were high with 96% of teachers

responding.

The TSR questionnaire was administered online using SurveyMonkey.

One week prior to survey collection, an incentive gift (small notepad) and memo

were sent to each teacher in the 45 schools. On the first day of data collection we

sent each teacher an invitation to complete the questionnaire along with directions

on how to complete it. This information was provided through email and via

paper memoranda placed in the teachers' school mailboxes. Survey directions

included a web link to access the questionnaire on SurveyMonkey. Every four to

five days we sent a reminder email to teachers who had not yet responded to the

survey invitation. Response rates for the TSR survey were high with 84% of

teachers responding.

Measures

Teacher-student relations and student behavior for individual students

were assessed with the TRSB survey consisting of 16 items measuring the

closeness of teacher-student relationship and problem behaviors. Teacher

characteristics were assessed with the TSR survey consisting of 18 items

measuring instructional practices. Student background characteristics and

achievement information were obtained from the PWCS archival files.

Descriptive statistics and reliabilities for both student-level and classroom-level

variables are summarized in Table 2.

Student-level variables

All student-level variables were standardized (i.e., mean = 0 and standard

deviation = 1) at the student-level.

Student academic grades are the student report card grade from the fourth

quarter of the 2006-07 school year for grades kindergarten through fifth. The

grades were calculated by averaging across five core content areas (math, reading,

writing, science and social studies).

Standardize achievement scores are measured by a set of standardized

criterion-referenced tests, the Standards of Learning (SOL) in Virginia, from the

2006-07 school year for grades third through fifth. The SOL scores were

calculated by averaging across two subtests (i.e., reading and math).

Close teacher-student relationship is a four-item measure of the extent to

which a teacher feels that his or her relation with the student being assessed is

characterized by closeness, warmth, affection and open communication. Sample

items for this scale are "I share a warm caring relationship with this child," "If

upset this child will seek me out for support" and "This child spontaneously

shares his feelings and experiences with me." The items are rated on a five-point

Likert-type scale (i.e., 0 = Definitely does not apply, 1 = Not really, 2 =

Neutral/not sure, 3 = Applies somewhat and 4 = Definitely applies). This

composite is a subset of items adapted from research by Pianta (2001).

Student-level Covariates

Behavioral problem measures the degree to which students have difficulty regulating their behavior, emotions and their interactions with other people. A total of 12 items adapted from two sources converged to form this behavioral problem scale. Eight items measuring externalizing behaviors (adapted from the Teacher Observation of Child Adaptation, Revised, TOCA-R, measure by Werthamer-Larsson, Kellam, & Wheeler, 1991) and four items representing conflictual behaviors (adapted from research by Pianta, 2001). Sample externalizing items include "Defies teachers or other school personnel," "Is physically aggressive or fights with others" and "Teases or taunts others." The items are rated on a four-point Likert-type scale (i.e., 0 = Never/Almost never, 1 = Sometimes, 2 = Often and 3 = Very Often) (Werthamer-Larsson, Kellam, & Wheeler, 1991). The sample items for conflictual behaviors include "This child and I always seem to be struggling with each other," "This child's feelings toward me can be unpredictable or change suddenly" and "This child is sneaky or manipulative with me." The items are rated on a 5-point Likert-type scale (i.e., 0 = Definitely does not apply, 1 = Not really, 2 = Neutral/not sure, 3 = Applies somewhat and 4 = Definitely applies) (Pianta, 2001). To create the composite behavioral problem scale, the 12 items were standardized (i.e., mean = 0 and standard deviation =1) then averaged at the individual student level.

Prior academic performance is the students' prior academic grades or achievement scores. When using the student academic grades as the outcome, student prior academic performance for grades one through five is the student

report card grade for the 2005-06 school year. The grades were calculated by first averaging across the four quarters of the school year and then averaging across the five core subjects (i.e., math, reading, writing, science and social studies). The kindergarten students did not attend school the year prior. Therefore, prior academic performance for kindergarten students is the report card grade from the first quarter for the school year 2006-07. The grades were calculated by averaging across the five core subjects (i.e., math, reading, writing, science and social studies).

When using the standardized achievement scores as the outcome, student prior achievement scores for grades four and five are the SOL scores from the 2005-06 school year. The scores were averaged across the reading and math subtests, and the prior achievement scores ranged from 200 to 600. The third grade students were not required to take the SOL achievement test the year before. Therefore, the prior performance for third grade is the report card grades from the 2005-06 school year. The grades were averaged across the reading and math contents.

Academic risk index is the sum of three student characteristics: minority ethnicity (i.e., not Caucasian or Asian), free and reduced meal (FARM) status (i.e., student receiving FARM assistance), and English Speakers of Other Language (ESOL) status (i.e., student receiving ESOL services). The sum ranged from 0 to 3. The composite academic risk index was created to avoid problems of multicollinearity had these highly correlated student characteristics been included as separate covariates in the statistical models.

Classroom-level Variables: Classroom Characteristics

Class mean of close teacher-student relations is the average of the close teacher-student relation scale in each classroom. This variable was first aggregated to the classroom-level and then standardized across classrooms (i.e., mean = 0 and standard deviation = 1).

Instructional Practices is an 18-item measure of the teaching practices and performance of the teachers within the classroom written for the present research. Sample items are "I develop my lesson so that I do not have the student work on too much unknown material at once," "I take the time to assess the student's prior knowledge and skills before teaching a lesson" and "I set and monitor progress towards short-term goals." The items are rated on a five-point Likert-type scale (1 = Almost never, 2 = A few lessons a week, 3 = A couple lessons per day, 4 = Almost every lesson per day and 5 = Every lesson per day). Earlier research using this composite was reported by Kaiser (2007). The instructional practices variable was standardized.

Classroom academic risk index is the average of the academic risk index for each classroom. This variable was first aggregated to the classroom-level and then standardized across classrooms.

Data Analysis

A two-level hierarchical linear models (Raudenbush & Bryk, 2002) in which students are nested within classrooms is used to test the associations between teacher-student relations, classroom characteristics and student academic achievement. The level-1 model is:

$$Y_{ij} = \beta_{0j} + \beta_{1j}(X_1 - X_{1ij}) + \beta_{2j}(X_2 - X_{2ij}) + \beta_{3j}(X_3 - X_{3ij}) + \beta_{4j}(X_4 - X_{4ij}) + r_{ij} \qquad (1)$$

where Y_{ij} is the student academic achievement for the ith student in the jth classroom,

β_{0j} is the intercept or the average covariate-adjusted student academic achievement in the jth classroom,

β_{1j} is the slope for the regression of student academic achievement on the covariate (student prior academic achievement) in the jth classroom,

β_{2j} is the slope for the regression of student academic achievement on the covariate (academic risk index) in the jth classroom,

β_{3j} is the slope for the regression of student academic achievement on the covariate (close teacher-student relations) in the jth classroom,

β_{4j} is the slope for the regression of student academic achievement on the covariate (behavior problem) in the jth classroom,

X_{1ij} is student prior academic achievement for student i in classroom j,

X_{2ij} is academic risk index for student i in classroom j,

X_{3ij} is close teacher-student relations for student i in classroom j,

X_{4ij} is behavior problem for student i in classroom j, and

r_{ij} is residual error for student i in classroom j.

The level-2 model consists of 5 equations:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}W_{1j} + \gamma_{02}W_{2j} + \gamma_{03}W_{3j} + u_{0j} \tag{2}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}W_{1j} + \gamma_{12}W_{2j} + \gamma_{13}W_{3j} + u_{1j} \tag{3}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}W_{1j} + \gamma_{22}W_{2j} + \gamma_{23}W_{3j} + u_{2j} \tag{4}$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31}W_{1j} + \gamma_{32}W_{2j} + \gamma_{33}W_{3j} + u_{3j} \tag{5}$$

$$\beta_{4j} = \gamma_{40} + \gamma_{41}W_{1j} + \gamma_{42}W_{2j} + \gamma_{43}W_{3j} + u_{4j} \tag{6}$$

where β_{0j} is the average covariate-adjusted student academic achievement in the jth classroom,

γ_{00} is the grand mean student academic achievement for all classrooms,

γ_{01} through γ_{03} are the increment to the average student academic achievement for W_1 to W_3,

β_{1j} is the slope in the partial regression of current academic achievement on prior performance in the jth classroom,

γ_{10} is the average slope in the partial regression of current academic achievement on prior academic performance for all classrooms,

γ_{11} through γ_{13} are the increment to the slope in the partial regression of current academic achievement on prior academic performance for a unit change in W_1 to W_3,

β_{2j} is the slope in the partial regression of academic achievement on academic risk index in the jth classroom,

γ_{20} is the average slope in the partial regression of academic achievement on academic risk index for all classrooms,

γ_{21} through γ_{23} are the increment to the slope in the partial regression of academic achievement on academic risk index for a unit change in W_1 to W_3,

β_{3j} is the slope in the partial regression of academic achievement on close teacher-student relations in the jth classroom,

γ_{30} is the average slope in the partial regression of academic achievement on close teacher-student relations for all classrooms,

γ_{31} through γ_{33} are the increment to the slope in the partial regression of academic achievement on close teacher-student relations for a unit change in W_1 to W_3,

β_{4j} is the slope in the partial regression of academic achievement on behavioral problems in the jth classroom,

γ_{40} is the average slope in the partial regression of academic achievement on behavioral problem for all classrooms,

γ_{41} through γ_{43} are the increment to the slope in the partial regression of academic achievement on behavioral problems for a unit change in W_1 to W_3,

W_1 is class mean of close teacher-student relations,

W_2 is teacher instructional practice,

W_3 is academic risk index aggregated to the classroom level and

u_{1j} to u_{4j} are the residual errors for classroom j.

Analyses proceeded in stages. The first step examined the level-one (student-level) associations with academic achievement. Then prior academic performance, academic risk index, teacher-student relations and student behavior problem were tested as potential covariates, retaining statistically significant covariates in the model and dropping those that failed to significantly predict

achievement. Then, the hypotheses that student-level slopes are equal were tested. If the null hypothesis of equal slopes could be retained, slopes were fixed in further analyses. If a null hypothesis of equal slopes was rejected, slopes were free to vary in further analyses. The second step of the analysis examined, level-two (classroom) characteristics hypothesized to influence student academic achievement. Specifically, I examined whether class mean of close teacher-student relation, teacher instructional practices and classroom mean of academic risk index predicted student academic achievement. The third step of the analysis examined the cross-level interaction of classroom characteristics and close teacher-student relation on student academic achievement for those level-one variables with random slopes. In other words, analyses examined whether classroom-level variables explained the varying slopes.

The same two-level hierarchical linear model was used to examine the influences of teacher-student relation and classroom characteristics on both of the student academic achievement outcomes, report card grades and standardized achievement scores. Furthermore, similar analyses were conducted separately for each grade level to determine whether coefficients were similar across grades.

Chapter 3

Results

Correlations Between Student-Level and Classroom-Level Variables

The correlations among student-level variables and among classroom-level variables for grades kindergarten through five are presented in Table 3. The bivariate correlations ranged from 0.06 to 0.70. The relationships were all in the expected direction. There was a high correlation between academic grades and standardized achievement scores. Students with higher academic grades and higher achievement scores tend to perform better academically in the prior school year, have less academic risk characteristics, have close relationships with their teacher and are less likely to be identified as having behavior problems.

The correlations between classroom-level variables indicate similar relationship patterns with varying degrees of significance, the *r* coefficients ranged from 0.01 to 0.72. The classroom-level correlations indicated that classrooms with higher averages of academic grades have higher class averages of standardized scores, class averages of close teacher-student relationships, and teacher reported use of instructional practices. However, classrooms with higher averages of academic grades have lower class averages of academic risks. Further, class averages of close teacher-student relationships were correlated with higher teacher reported use of instructional practices and lower class averages of academic risks. The correlations between student-level variables and between classroom-level variables for grades kindergarten through five were also calculated separately and are presented in Appendix A through F.

Results for Student Academic Grades:

Proportion of Variance Explained for Student Academic Grades

The proportions of variance explained within and between classrooms for the student academic grades are presented in Table 4. The intraclass correlation (ICC) coefficient measures the proportion of variance in the outcomes that lies between classrooms. The ICC for the fully unconditional model indicated that much variance lies between classrooms for student academic grades. The ICC coefficients ranged from 15% to 21%. For example, 17% of the variance in the academic grades lies between classrooms for the kindergarten level.

Results from the fully unconditional and the final models were used to estimate the proportion of variance explained between and within classrooms (at the individual student level). The final model explained the most between classrooms variance for the second grade level. For the second grade level, 52% of the between classroom variance and 52% of the within classroom variance were explained by the final model. The final model explained the least between classrooms variance for the fourth grade level. For the fourth grade level, 15% of the between classroom variance and 65% of the within classroom variance were explained by the final model.

Student-level Associations with Student Academic Grades

The first stage of analysis with student academic grades as the outcome is examined in this section. This stage examines whether student-level variables, close teacher-student relations, prior academic performance, academic risk index,

and student behavioral problem, influence student academic grades. Part A of Table 5 presents the results for the student-level associations with student academic grades. The results indicated that all of the student-level variables significantly influenced student academic grades across all grade levels, kindergarten through fifth grade.

Most importantly, results indicated that students with close relationships with their teachers had significantly higher academic grades across all grade levels, coefficients ranged from 0.06 to 0.12, all $p < 0.01$, controlling for the student's prior academic performance, academic risk index and behavior problems. In general, the kindergarten grade level results indicated that a one standard deviation increase in close teacher-student relation was associated with a 0.12 standard deviation increase on student grades (based on standard scores), controlling for all other variables.

Furthermore, results indicated that students with behavior problems had significantly lower academic grades across all grade levels, coefficients ranged from -0.08 to -0.15, all $p < 0.001$ (based on standard scores), controlling for the student's relationship with the classroom teacher, prior academic performance and academic risk index.   Students with higher prior academic performance had significantly higher academic grades across all grade levels, coefficients ranged from 0.52 to 0.71, all $p < 0.001$ (based on standard scores), controlling for the student's relationship with the classroom teacher, academic risk index and behavior problems.   Students with more academic risk had significantly lower academic grades across all grade levels, coefficients ranged from -0.08 to -0.18,

all $p < 0.001$ (based on standard scores), controlling for the student's relationship with the classroom teacher, prior academic performance and behavior problems.

Classroom-level Associations with Student Academic Grades

The second stage of analysis with student academic grades as the outcome is examined in this section. This stage examines whether classroom-level variables, classroom mean closeness of teacher-student relations, teacher instructional practices and classroom mean of the academic risk influence student academic grades. Part B of Table 5 presents the results for the classroom-level associations with student academic grades. One significant classroom level predictor was found--teacher instructional practices.

Results indicated that classrooms where teachers with better instructional practices had students with significantly higher academic grades for grade five, coefficient = 0.10, $p < 0.001$, controlling for all other student-level and classroom-level variables. In general, the fifth grade level results indicated that a one standard deviation increase in teacher instructional practices was associated with a tenth of a standard deviation increase in student grades (based on standard scores), controlling for all other variables. No other classroom-level variables were significantly associated with average covariate-adjusted grades.

Cross-level Interaction Effects of Classroom Characteristics and Student Variables on Student Academic Grades

The third stage of analysis with student academic grades as the outcome is examined in this section. This stage examines the cross-level interaction effects of classroom characteristics and student variables on student academic grades

only for student-level slopes that significantly varied. Part C of Table 5 presents the results for the cross-level interactions with student academic grades.

A very small significant cross-level interaction effect was found. Even though the there was a very small effect, the inclusion of the class mean of academic risk at level two explained 15% of the variance for the close teacher-student relations slope. After the classroom academic risk was accounted for in the model, the close teacher-student relations slope was no longer significantly varying.

The association between close teacher-student relations and academic grades was differentially affected by class average of academic risk. For kindergarten, higher classroom average academic risk significantly increased the slope of the regression of academic grades on the closeness of teacher-student relations, coefficient 0.03, $p < 0.05$, controlling for all other student-level and classroom-level variables (based on standard scores). In other words, the association between close teacher-student relations and academic grades was significantly stronger for classrooms with higher averages on the academic risk index. Conversely, the association between close teacher-student relation and academic grades was significantly weaker for classrooms with lower averages on the academic risk index. Figure 2 displays the significant interaction for kindergarten.

Student Grade Level Variations

The influences of classroom characteristics and student-level variables on student academic grades varying as a function of student grade level are examined

in this section. Table 5 presents the patterns of results across grade levels

Kindergarten through fifth. The student-level variables influenced student

academic grades consistently across all grade levels, suggesting that younger

elementary students and older elementary students are similarly, positively

influenced by having a close relationship with their teachers. The pattern of

classroom-level effects on student academic grades was consistent across the

student grade levels. Specifically referring to teacher instructional practices,

although statistical significance was found only for grade five, the positive effects

between teacher instructional practices and academic grades across all grade

levels suggests that younger and older elementary students are similarly,

positively influenced by teachers who use good instructional practices.

Results for Student Achievement Scores:

Proportion of Variance Explained for Student Achievement Scores

The proportions of variance explained by the HLM models for the student

standardized achievement scores are presented in Table 6. The ICC for the fully

unconditional model indicated that 13% to 16% of the variance in the

achievement scores lies between classrooms.

Results from the fully unconditional and the final models were used to

estimate the proportion of variance explained between and within classrooms.

The final model explained the most between classrooms variance for the fifth

grade level.   For the fifth grade level, 77% of the between classroom variance

and 67% of the within classroom variance were explained by the final model.

The final model explained the least between classrooms variance for the third grade level. For the third grade level, 63% of the between classroom variance and 47% of the within classrooms variance were explained by the final model.

Student-level Associations with Student Achievement Scores

The first stage of analysis with student standardized achievement scores as the outcome is examined in this section. This stage examines whether student-level variables, prior academic performance, academic risk index, close teacher-student relations and student behavioral problem, influence student standardized achievement scores. Part A of Table 7 presents the results for the student-level associations. The results indicated that most of the student-level variables significantly influenced student standardized achievement scores across all grade levels, third through fifth grade.

Results indicated that students with close relationships with their teachers had small but significantly higher standardized achievement scores for third grade, coefficient = 0.03, $p < 0.05$, and fourth grade, coefficient = 0.04, $p < 0.05$, controlling for the student's prior academic performance, academic risk index and behavior problems.   In general, the third grade level results indicated that a one standard deviation increase in close teacher-student relation was associated with a 0.03 standard deviation increase in student standardized achievement scores (based on standard scores), controlling for all other variables. However, the association between close teacher-student relations and student standardized achievement scores was not significant for the fifth grade.

Further, results indicated that students with behavior problems had significantly lower standardized achievement scores across third through fifth grade, coefficients ranged from -0.06 to -0.08, all $p < 0.001$ (based on standard scores), controlling for the student's relationship with the classroom teacher, prior academic performance and academic risk index. Students with higher prior academic performance had significantly higher current student standardized achievement scores across all grade levels, coefficients ranged from 0.55 to 0.74, all $p < 0.001$ (based on standard scores), controlling for the student's relationship with the classroom teacher, academic risk index and behavior problems. Students with more academic risks had significantly lower standardized achievement scores across all grade levels, coefficients ranged from -0.07 to -0.17, all $p < 0.001$ (based on standard scores), controlling for the student's relationship with the classroom teacher, prior academic performance and behavior problems.

Classroom-level Associations with Student Standardized Achievement Scores

This stage examines whether classroom-level variables, classroom mean of close teacher-student relation, teacher instructional practices and classroom mean of the academic risk influence student standardized achievement scores. Results for the classroom-level associations with student standardized achievement scores are presented in Part B of Table 7. One significant classroom level variable was found—class mean academic risk.

Classroom-level results indicated that classrooms with higher average academic risk had students with significantly lower standardized achievement scores for the fifth grade level, coefficient = -0.06, $p < 0.01$, controlling for all

student-level and other classroom-level variables. The fifth grade classrooms with one standard deviation increase in class average on the academic risk index were estimated to score -0.06 standard deviations lower on student standardized achievement scores (based on standard scores). All other classroom-level variables were not significantly associated with student standardized achievement scores.

Cross-level Interaction Effects of Classroom Characteristics and Student Variables on Student Standardized Achievement Scores

The cross-level interaction effects of classroom characteristics and close teacher-student relations on student standardized achievement scores are examined only if the close teacher-student relation slopes significantly varied across classrooms. Given that the close teacher-student relation slopes did not significantly vary, further cross-level examination was not conducted.

The examination of whether student grade levels differentially effects the association between classroom characteristics, student-level variables and student standardize achievement scores was not conducted. The full range of student grade levels were not available for the comparison because younger elementary students, grades kindergarten through second, were not required to take the standardize achievement tests.

Chapter 4

Discussion

The present study uses multi-level models to examine the influences of close teacher-student relations, classroom characteristics, and the cross-level interactions between classroom characteristics and teacher-student relations on student academic achievement across different grade levels.

Student-level Associations with Student Academic Performance

As hypothesized, the results from this study are consistent with past research suggesting that the quality of the relationship between teacher and students influences student academic performance. Findings from this study provide further support for Pianta's teacher-student relationship theory, suggesting that when teacher feels close with the student, the teacher may be more motivated to help the student academically succeed (Pianta et al., 1995; Hamre, & Pianta, 2001). This study also found evidence of other student-level characteristics influencing how students perform academically. As expected, students with behavior problems and students with many academic risks are likely to perform poorer academically. Students with higher achievement in previous years continue to perform better academically.

Classroom-level Associations with Student Academic Performance

Two of the three hypothesized classroom characteristics were found to be significant predictors of academic performance. Results from this study provide additional support for the eecological perspective (Bronfenbrenner, 1979) that students are academically influenced by their ecological context, specifically the

classroom characteristics. First, teacher use of recommended instructional practices was found to influence student academic performance for one grade level. Findings reflect past research, implying that effective instructional practices used in the classroom are instrumental to the student's academic development (Mashburn et al., 2008). The results suggest that when teachers use specific child-centered strategies and methods in the classroom to instruct their students, such as monitoring the student's progress towards goals, developing and presenting lessons at the student's level, students from those classrooms learn the content more and obtain better grades.

Second, this study found that classrooms with higher mean academic risks have a negative effect on academic performance, which suggests that the clustering of students with many academic risks within a classroom may create a classroom atmosphere that interferes with individual student learning.

Cross-level Interaction Effects on Student Academic Performance

None of the hypothesized interaction was supported; classroom characteristics did not influence the regression of student academic performance on student-teacher relations. An unexpected and small cross-level interaction resulted from the analysis. Specifically, the positive effects of having a close teacher-student relation on academic performance are slightly stronger in classrooms with higher average academic risk.

One possible explanation is that there are more students at-risk for school failure and more vulnerable students in the higher academic risk classrooms. The students may not have many other supportive relationships; as a result, these

students value the teacher more and are willing to try harder for the teacher that they closely relate with. Therefore, the quality of teacher-student relations has more of an effect on student academic grades in classrooms with higher mean academic risk. One may speculate that classrooms with lower mean academic risk (i.e., more advantaged students) have students who are not as vulnerable and have other supportive relationships outside of the classroom. Therefore, these students are not as willing to try harder, consequently, the influence of close teacher-student relations on student academic grades are weaker. Given that this cross-level interaction is very small and hard to understand, caution should be used when interpreting the results. Hence, future studies might engage in further examination to learn if this unexpected interaction is replicable.

Student Grade Level Variations

Results from this study did not support the hypothesis that the influences of teacher-student relations and classroom characteristics on student academic achievement are differentially affected by student grade level. Students from kindergarten through fifth grade all had similar significant associations between teacher-student relationship and student academic grades. Teacher's self-reported use of recommended instructional practices was positively related to student academic grades at all grade levels, although the results were not significant across all grade levels.

Limitations

As with most studies, the results reported in this study should be considered in light of the limitations. The first limitation is the ambiguous

temporal precedence which threatens the direction of causal inference. The multi-level analysis method used to examine the associations among the variables does not permit confident conclusions of causality. Even though the theory posits that positive classroom characteristics and close teacher-student relations influence student academic achievement, it is unclear whether classroom characteristics and close teacher-student relations precedes student academic achievement or vice versa. It is possible that students with higher academic performance create a classroom environment that enables the teacher to use more effective instructional practices and to develop closer relations with the students.

The self-report method was used to collect information on teacher-student relations, instructional practices and student behaviors. This method assumes that teacher responses to survey items reflect their actual relations and classroom practices. The teacher practices may be biased assessments, as their ratings may reflect desirable instructional practices instead of actual practices in the classroom. Similarly, the quality of the relations between the teacher and student may be biased, as the ratings may reflect only the teacher's perception about the relations and not the student's perception of the relations. The student could have perceived the relations differently than did the teacher. Furthermore, student report card grades were assigned by the teachers, and they may share common method variance with other teacher reports. For instance, the grades assigned by the teachers as well as the teachers' assessments of closeness may reflect the student's behavior or effort or any number of potential teacher biases. If future research incorporates additional measures, such as classroom observations of

teacher practices, peer teacher ratings of practices, student ratings on the relations with the teacher, or student standardized scores, concerns about the validity with which these constructs are measured could be attenuated.

Finally, a potential limitation is that the results are based on a sample of suburban public elementary schools in the mid-Atlantic region. This school system volunteered to participate in an experimental investigation of a school wide intervention. The extent to which results based on this sample to schools that differ in their demography or amenability to research is not known.

Implications

Prior research and theoretical speculation provided a basis for hypothesizing that teacher-student relation, classroom characteristics, and there interactions would produce improved student academic development. However, limitations in prior research prevented conclusive interpretation of results, specifically, lack of multilevel analysis, lack of cross-level interactions among the variables, and lack of multiple grade level analysis, Therefore, the present study attempted to address many of the limitations.

The multilevel method used in this study provides evidence of both student- and classroom-level influences on student achievement. The statistical model teases apart the influence of teacher-student relations at the individual level and its interactions with classroom characteristics on student academic achievement. The results provide a clearer understanding of the mechanisms that underlie student academic achievement by implying that student academic

success requires a combination of close support from the teacher, teachers who use good instructional practices, and classrooms with less academic risks.

The study contributes evidence about grade level consistency regarding the influence of teaching practices and teacher-student relations. The consistent results across grade levels suggest that younger elementary and older elementary students perceive positively to close teacher relations and teacher use of good instructional practices.

Multilevel analyses using two different achievement outcomes, student academic grades and standardized achievement scores, provide further support for the inference that close teacher-student relations are useful in the improvement of student academic achievement, and that teachers' self-reports of their relationships with the students have some validity.

Finally, the results provide some support for the construct validity of teacher self-reports of instructional practices. These self-reports, at least for instructional practices, predict achievement net of prior achievement and other student and classroom characteristics.

Future Research

In light of the limitations and implications of this study, future investigations should replicate the results found in this study to provide researchers and educators with more confidence in the positive effects of close teacher-student relations and teacher utilization of effective instructional practices on student academic performance, especially for the effects of teacher use of effective instructional practices on student standardized achievement scores.

In terms of the very small cross-level interaction effect that was found, specifically the association between close teacher-student relation and student achievement is slightly stronger in classrooms with more academic risk, subsequent exploration is required to learn if this unexpected interaction is replicable and if so, how it may come about.

Although 30 years of research implying that the classroom context is instrumental to student performance, this study did not find many classroom characteristics and many cross-level interactions to influence student academic performance. This may be due to the present study having limited classroom contextual variables. There are many other classroom variables that may be important to the process of student academic process. Hence, future research using a more comprehensive perception of classroom context to determine which classroom characteristics influence student academic development may be helpful to develop a clearer understanding of how to best help students by classroom ecological arrangements.

Appendix A

Correlations Between Student-Level and Classroom-Level Variables for the

Kindergarten Students

Variables	1	2	3	4	5
Student-level (N = 3,924)					
1 (Outcome) Academic grades	-	0.19**	-0.15**	0.68**	-0.34**
2 Close teacher-student relations		-	-0.23**	0.13**	-0.08**
3 Behavior Problem			-	-0.11**	0.01
4 Prior academic performance				-	-0.38**
5 Academic risk index					-
Variables	1	2	3	4	
Classroom-level variables (N = 138)					
1 Class mean of academic grades	-	0.03	0.07	-0.45**	
2 Class mean of close teacher-student relation		-	0.12	-0.01	
3 Teacher instructional practices			-	-0.04	
4 Class mean of academic risk index				-	

Note. ** = $p < 0.01$. * = $p < 0.05$.

Appendix B

Correlations Between Student-Level and Classroom-Level Variables for the

First Grade Students

Variables	1	2	3	4	5
Student-level (N = 4,305)					
1 (Outcome) Academic grades	-	0.19**	-0.21**	0.55**	-0.34**
2 Close teacher-student relations		-	-0.29**	0.12**	-0.07**
3 Behavior Problem			-	-0.14**	0.04*
4 Prior academic performance				-	-0.40**
5 Academic risk index					-
Variables	1	2	3	4	
Classroom-level variables (N = 175)					
1 Class mean of academic grades	-	0.14	0.15	-0.48**	
2 Class mean of close teacher-student relation		-	0.22**	-0.03	
3 Teacher instructional practices			-	-0.05	
4 Class mean of academic risk index				-	

Note.   ** = $p < 0.01$.   * = $p < 0.05$.

Appendix C

Correlations Between Student-Level and Classroom-Level Variables for the

Second Grade Students

Variables	1	2	3	4	5
Student-level (N = 4,304)					
1 (Outcome) Academic grades	-	0.27**	-0.28**	0.62**	-0.43**
2 Close teacher-student relations		-	-0.29**	0.18**	-0.15**
3 Behavior Problem			-	-0.22**	0.08**
4 Prior academic performance				-	-0.40**
5 Academic risk index					-

Variables	1	2	3	4	
Classroom-level variables (N = 176)					
1 Class mean of academic grades	-	0.40**	0.18*	-0.67**	
2 Class mean of close teacher-student relation		-	0.32**	-0.27**	
3 Teacher instructional practices			-	-0.02	
4 Class mean of academic risk index				-	

Note. ** = $p < 0.01$. * = $p < 0.05$.

Appendix D

Correlations Between Student-Level and Classroom-Level Variables for the

Third Grade Students

	Variables	1	2	3	4	5	6
	Student-level ($N = 4{,}054$)						
1	(Outcome) Academic grades	-	0.72**	0.20**	-0.28**	0.64**	-0.42**
2	(Outcome) Standardize achievement		-	0.15**	-0.21**	0.65**	-0.45**
3	Close teacher-student relations			-	-0.24**	0.14**	-0.10**
4	Behavior Problem				-	-0.20**	0.05**
5	Prior academic performance					-	-0.47**
6	Academic risk index						-
	Variables	1	2	3	4	5	
	Classroom-level variables ($N = 165$)						
1	Class mean of academic grades	-	0.58**	0.20*	0.14	-0.62**	
2	Class mean of standardize acheivement		-	0.19*	0.11	-0.73**	
3	Class mean of close teacher-student relation			-	0.33**	-0.10	
4	Teacher instructional practices				-	-0.12	
5	Class mean of academic risk index					-	

Note. ** $= p < 0.01$. * $= p < 0.05$.

Appendix E

Correlations Between Student-Level and Classroom-Level Variables for the

Fourth Grade Students

Variables	1	2	3	4	5	6
Student-level (N = 3,982)						
1 (Outcome) Academic grades	-	0.70**	0.21**	-0.31**	0.69**	-0.36**
2 (Outcome) Standardize achievement		-	0.17**	-0.23**	0.71**	-0.42**
3 Close teacher-student relations			-	-0.30**	0.13**	-0.12**
4 Behavior Problem				-	-0.26**	0.09**
5 Prior academic performance					-	-0.44**
6 Academic risk index						-

Variables	1	2	3	4	5	
Classroom-level variables (N = 150)						
1 Class mean of academic grades	-	0.43**	0.24**	0.06	-0.53**	
2 Class mean of standardize acheivement		-	0.23**	-0.04	-0.68**	
3 Class mean of close teacher-student relation			-	0.40**	-0.20**	
4 Teacher instructional practices				-	0.10	
5 Class mean of academic risk index					-	

Note. ** = p < 0.01. * = p < 0.05.

Appendix F

Correlations Between Student-Level and Classroom-Level Variables for the

Fifth Grade Students

Variables	1	2	3	4	5	6
Student-level (N = 3,937)						
1 (Outcome) Academic grades	-	0.69**	0.18**	-0.27**	0.72**	-0.36**
2 (Outcome) Standardize achievement		-	0.14**	-0.20**	0.69**	-0.43**
3 Close teacher-student relations			-	-0.28**	0.18**	-0.10**
4 Behavior Problem				-	-0.30**	0.08**
5 Prior academic performance					-	-0.42**
6 Academic risk index						-

Variables	1	2	3	4	5	
Classroom-level variables (N = 142)						
1 Class mean of academic grades	-	0.50**	0.18*	0.18*	-0.52**	
2 Class mean of standardize acheivement		-	0.14	-0.06	-0.75**	
3 Class mean of close teacher-student relation			-	0.32**	-0.15	
4 Teacher instructional practices				-	0.06	
5 Class mean of academic risk index					-	

Note. ** = $p < 0.01$. * = $p < 0.05$.

Table 1

Participant Characteristics

Teachers (*N* = 946)		Students (*N* = 24,328)	
Gender		Gender	
Female	94%	Female	49%
Male	6%	Male	51%
Ethnicity		Ethnicity	
Caucasian	87%	Caucasian	41%
African American	8%	African American	20%
Hispanic	3%	Hispanic	27%
Asian	1%	Asian	7%
Other	1%	Other	5%
Grade Level		Grade Level	
Kindergarten	15%	Kindergarten	16%
1st grade	18%	1st grade	17%
2nd grade	19%	2nd grade	18%
3rd grade	17%	3rd grade	17%
4th grade	16%	4th grade	16%
5th grade	15%	5th grade	16%
Years of Teaching Experience			
1 year or less	7%	FARM	33%
2 to 5 years	30%	ESOL	26%
6 to 10 years	23%	Special Education	10%
11 to 20 years	22%		
More than 20 years	18%		

Note. FARM = Free and reduced meals; ESOL = English speakers of other language.

Table 2

Descriptive Statistics for Student and Classroom Data

Variables	Mean/ proportion	*SD*	Min	Max	Reliability
Student-level variables					
(Outcome) Academic grades	0.00	1.00	-4.29	1.69	0.89[a]
(Outcome) Standardize achievement	0.00	1.00	-3.26	1.72	0.88[a]
Close teacher-student relations	0.00	1.00	-5.06	1.09	0.86[a]
Behavior Problem	0.00	1.00	-0.70	6.05	0.92[a]
Prior academic performance	0.00	1.00	-4.59	2.54	0.96[a]
Academic risk index	0.00	1.00	-1.08	1.88	0.68[a]
Classroom-level variables					
Class mean of close teacher-student relations	0.00	0.98	-3.75	1.84	0.90[b]
Teacher instructional practices	0.00	1.00	-3.35	2.32	0.91[a]
Class mean of academic risk index	0.00	1.00	-1.84	2.36	0.92[b]

Note. [a] α, alpha, measuring internal consistency. [b] $\hat{\lambda}$, lamda hat, measuring average reliability for level-2 units. The statistics include grades kindergarten through fifth. All variables are standardized.

Table 3

Correlations Between Student-Level and Classroom-Level Variables

Variables	1	2	3	4	5	6
Student-level (*N* = 24,328)						
1 (Outcome) Academic grades	-	0.70**	0.21**	-0.25**	0.65**	-0.38**
2 (Outcome) Standardize achievement		-	0.15**	-0.22**	0.69**	-0.43**
3 Close teacher-student relations			-	-0.27**	0.15**	-0.10**
4 Behavior Problem				-	-0.21**	0.06**
5 Prior academic performance					-	-0.42**
6 Academic risk index						-

Variables	1	2	3	4	5	
Classroom-level variables (*N* = 946)						
1 Class mean of academic grades	-	0.51**	0.21**	0.13*	-0.55**	
2 Class mean of standardize acheivement		-	0.18**	0.01	-0.72**	
3 Class mean of close teacher-student relation			-	0.28**	-0.13**	
4 Teacher instructional practices				-	-0.01	
5 Class mean of academic risk index					-	

Note. ** = *p* < 0.01. * = *p* < 0.05. The academic grades include grades kindergarten through five. The standardized achievement scores includes grades three through five.

Table 4

Variance Components and Proportion of Variance Explained for Student Academic Grades

	Student Grade Level					
	K	1st	2nd	3rd	4th	5th
Unconditional Model:						
Sigma squared (σ^2)	0.82	0.80	0.80	0.80	0.86	0.79
Tau (τ)	0.17	0.18	0.21	0.19	0.15	0.19
Intraclass Correlation (ICC)	0.17	0.18	0.21	0.20	0.15	0.19
Final Model:						
Sigma squared (σ^2)	0.30	0.42	0.39	0.35	0.30	0.32
Tau (τ)	0.14	0.14	0.10	0.14	0.13	0.11
Variance Explained:						
Proportion of σ^2 explained	0.64	0.47	0.52	0.56	0.65	0.60
Proportion of τ explained	0.18	0.22	0.52	0.28	0.15	0.43

Note. σ^2 = within-class variance, τ = between class variance. Intraclass correlation is the proportion of total variance in the outcome between classes. ICC is computed as follows: ICC = τ unconditional/(τ unconditional + σ^2 unconditional). Proportion of σ^2 explained is computed as follows: (σ^2 unconditional - σ^2 final)/σ^2 unconditional. Proportion of τ explained is computed as follows: (τ unconditional - τ final)/τ unconditional.

Table 5

Summary of the Associations Between Student-Level Variables, Classroom Characteristics and Student Academic Grades

Variables	Kindergarten Coef.	SE	1st Grade Coef.	SE	2nd Grade Coef.	SE	3rd Grade Coef.	SE	4th Grade Coef.	SE	5th Grade Coef.	SE
A. Student-Level Associations												
Close teacher-student relation	0.12 ***	0.02	0.11 ***	0.02	0.06 **	0.02	0.10 ***	0.02	0.09 ***	0.02	0.06 ***	0.02
Problem behavior	-0.08 ***	0.02	-0.13 ***	0.02	-0.14 ***	0.02	-0.14 ***	0.01	-0.15 ***	0.02	-0.09 ***	0.01
Prior academic performance	0.71 ***	0.03	0.55 ***	0.03	0.52 ***	0.02	0.58 ***	0.02	0.68 ***	0.02	0.67 ***	0.02
Academic risk index	-0.08 ***	0.02	-0.10 ***	0.02	-0.18 ***	0.02	-0.12 ***	0.02	-0.09 ***	0.02	-0.08 ***	0.02
B. Classroom-Level Associations												
Mean close teacher-student relation	-0.06	0.03	-0.06	0.03	0.06	0.03	-0.05	0.03	-0.03	0.04	-0.06	0.03
Teacher instructional practices	0.05	0.03	0.04	0.03	0.03	0.03	0.06	0.03	0.06	0.03	0.10 ***	0.03
Mean academic risk index	0.05	0.04	-0.04	0.04	-0.05	0.03	0.01	0.04	0.06	0.04	0.00	0.04
C. Cross-Level Interactions												
Close Teacher-Student Relationship ×												
Mean close teacher-student relation	0.01	0.01	0.01	0.01	-0.02	0.02	0.01	0.02	-		-	
Teacher instructional practices	0.01	0.02	-0.01	0.02	0.01	0.02	0.00	0.02	-		-	
Mean academic risk index	0.03 *	0.01	0.02	0.02	0.01	0.02	0.01	0.02	-		-	

Note . - indicates that slopes did not significantly vary; therefore, further exploration was not done. $* < 0.05.$ $** < 0.01.$ $*** < 0.001.$

Table 6

Variance Components and Proportion of Variance Explained for Student Standardized Achievement Scores

	Student Grade Level		
	3rd	4th	5th
Unconditional Model:			
Sigma squared (σ^2)	0.83	0.88	0.84
Tau (τ)	0.16	0.13	0.14
Intraclass Correlation (ICC)	0.16	0.13	0.14
Final Model:			
Sigma squared (σ^2)	0.44	0.31	0.27
Tau (τ)	0.06	0.04	0.03
Variance Explained:			
Proportion of σ^2 explained	0.47	0.65	0.67
Proportion of τ explained	0.63	0.65	0.77

Note. σ^2 = within-class variance, τ = between class variance. Intraclass correlation is the proportion of total variance in the outcome between classes. ICC is computed as follows: ICC = τ unconditional/(τ unconditional + σ^2 unconditional). Proportion of σ^2 explained is computed as follows: (σ^2 unconditional - σ^2 final)/σ^2 unconditional. Proportion of τ explained is computed as follows: (τ unconditional - τ final)/τ unconditional.

Table 7

Summary of the Associations Between Student-Level Variables, Classroom Characteristics and Student Standardized Achievement Scores

Variables	3rd Grade		4th Grade		5th Grade	
	Coef.	SE	Coef.	SE	Coef.	SE
A. Student-Level Associations						
Close teacher-student relation	0.03 *	0.02	0.04 *	0.01	0.02	0.01
Problem behavior	-0.07 ***	0.01	-0.08 ***	0.01	-0.06 ***	0.01
Prior academic performance	0.55 ***	0.02	0.71 ***	0.01	0.74 ***	0.01
Academic risk index	-0.17 ***	0.02	-0.11 ***	0.02	-0.07 ***	0.02
B. Classroom-Level Associations						
Mean close teacher-student relation	0.01	0.02	-0.04	0.03	-0.02	0.02
Teacher instructional practices	0.02	0.02	-0.01	0.02	0.00	0.02
Mean academic risk index	-0.02	0.03	0.02	0.02	-0.06 **	0.02
C. Cross Level Interactions						
Close Teacher-Student Relationship ×						
Mean close teacher-student relation	-		-		-	
Teacher instructional practices	-		-		-	
Mean academic risk index	-		-		-	

Note. Prior performance for grade 3 is the student math and reading report card grades for 06. Prior performance for grades 4 and 5 is their SOL 06 scores. - indicates that slopes did not significantly vary; therefore, further exploration was not done. * < 0.05. ** < 0.01. *** < 0.001.

Figure Caption

Figure 1. Conceptual model for examining the associations between teacher-

student relations, classroom characteristics and student academic achievement.

Classroom-level variables:
Classroom Characteristics
- Classroom mean of close teacher-student relations
- Teacher instructional practices
- Classroom mean of academic risk index

Student-level variable:

Close teacher-student relations

Outcome: Student Academic Achievement
- Student academic grades
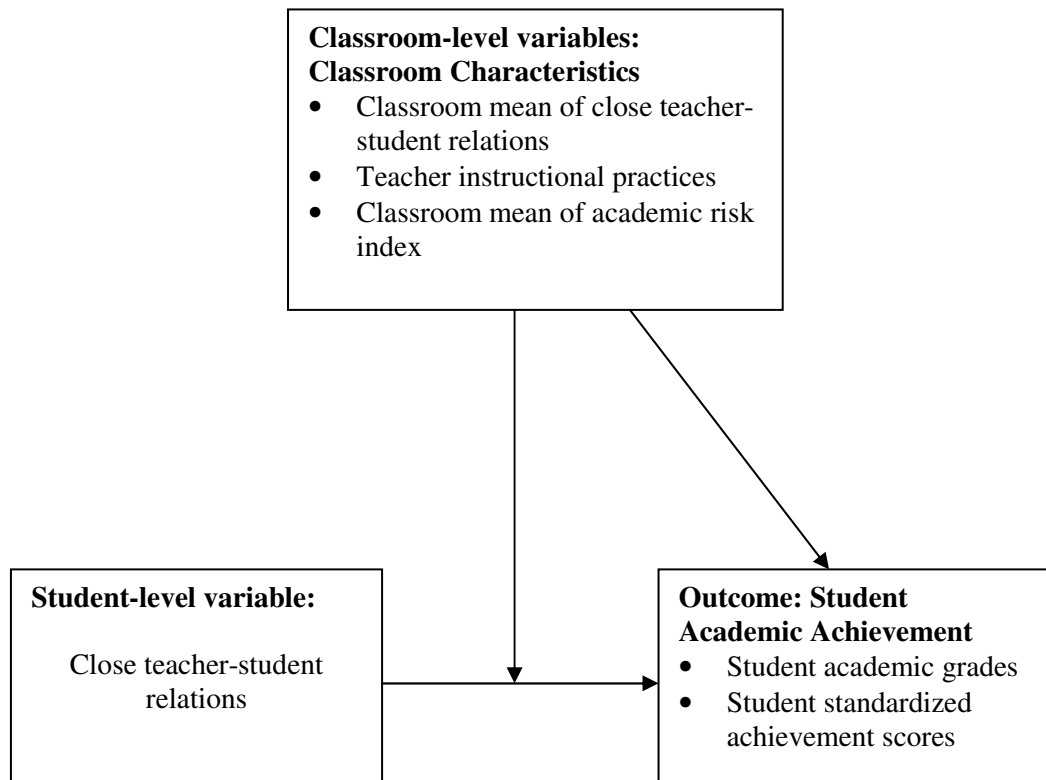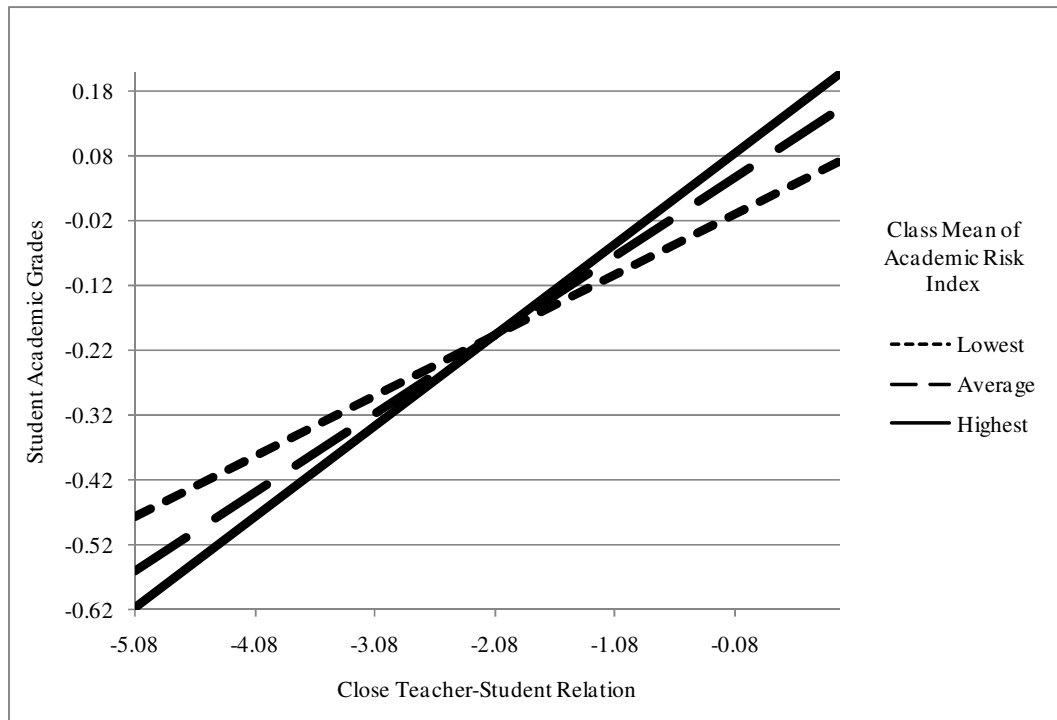- Student standardized achievement scores

Figure Caption

Figure 2. Association between close teacher-student relation and academic

grades as a function of classroom mean of academic risk index for kindergarten

grade.

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