

Trust and Friction: A Multi-Level Analysis of Elementary Math Classrooms in Texas

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Abstract

Understanding how to maximize classroom climate factors that may positively affect student achievement scores in mathematics is vital to school improvement efforts. This study examines the impact teacher trust in clients and classroom friction have on elementary math achievement. Both student and teacher perceptions are explored. Surveys were collected from 482 students and their teachers from 26 math classrooms across ten elementary schools in Texas. Intraclass correlations were calculated to identify the level of variation in math achievement between classrooms. Next, a random coefficient HLM model was employed to identify the specific impacts that teacher trust in students and parents and classroom friction have on elementary math achievement. Finally, an intercepts as slope HLM model was created to isolate potential interaction effects between Level 1 (classroom) and the Level 2 (school) variables. The results of the analyses indicate that both teacher trust in clients and classroom friction make statistically significant impacts on the variance in elementary math achievement. Teacher years of experience on campus and socioeconomic status are also examined. Implications are discussed.

Keywords: teacher trust, classroom friction, classroom climate, math achievement, and math anxiety

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Introduction

According to the U.S. Secretary of Education, “Our students are on the path to progress... (but) we still have a long journey to go before all of America’s children get an excellent education” (Duncan, 2012). In particular, there has been a strong push recently to enhance mathematics education, as math is seen as a gateway to future employment opportunities (Kerry, 2004). Hiring and retaining qualified math teachers at the K-12 level remains a challenge (McCoubrey, 2001). In order to be effective instructors, math teachers must not only understand the curriculum, they must also be able to connect well with their students (Lewis, Ream, Bocian, Cardullo, Hammond, & Fast, 2012).

This study was undertaken in order to identify some of the specific aspects of classroom climate that may significantly affect math achievement. This work is grounded in the conceptual model of Hoy, Tarter, & Woolfolk Hoy (2006), Goddard, Salloum, & Berebitsky (2009), and Tschannen-Moran (2009) who have each explored various aspects of trust in schools. Importantly, this research attempts to expand upon these authors’ work by exploring not only teachers’, but also students’ perceptions of relationships at the classroom level. By conducting this study, the authors hope to add useful information to the extant literature on classroom climate and elementary math achievement. In order to inform our investigation, the discussion now turns to a review of the literature.

Literature Review

Much has been written about mathematics, student achievement, and classroom climate but there is relatively little research that has been conducted in regard to the relationship between teacher trust, classroom friction, and math achievement at the elementary level. We plan to

investigate how these variables interact with each other and collectively. Researchers who have studied math achievement have identified the context of the classroom as an area that may provide much needed information to guide practice and policy (Rivkin, Hanushek, & Kain, 2005).

Since the release of *A Nation at Risk: The Imperative for Educational Reform* (U.S., 1983), public schools have been described as being “eroded by a rising tide of mediocrity that threatens our very future as a nation and a people” (United States National Commission on Excellence in Education, 1983, p. 5). Berliner and Biddle (1995) questioned the statistical methodology and citations for the findings and asserted that the report was misleading the nation about our public school systems in their book. The report focused on high school findings, while disregarding the importance and role of K-8th grade education (Peterson, 2003). Goodlad (2003) argued that the connection between the nation’s economy and student achievement was “overstated” in the government report. Although many educational reform efforts have been implemented since *A Nation at Risk* was published, our educational system still faces a number of challenges, in particular in the area of math (United States Department of Education, 2008).

Math Achievement

“National achievement data show that elementary school students in the United States, particularly those from low socioeconomic backgrounds, have weak math skills” (Argodini, Harris, Thomas, Murphy, & Gallagher, 2009, p. 1). There are many factors that can affect student achievement in math, including but not limited to: gender bias, self-confidence, parental involvement, learning styles, family structure, previous experiences in math, level of education of parents, and emphasis placed on education at home (Campbell, Hombo, & Mazzeo, 2000;

Epstein, 1991; Fennema & Peterson, 1986; National Commission on Children, 1991; White, 2001).

It is certainly true that a student's academic achievement is a "cumulative function of current and prior family, community, and school experiences" (Rivkin, Hanushek, & Kain, 2005, p. 422). Rivkin and his colleagues performed a longitudinal study in Texas about academic achievement that took a closer look at teacher and classroom level factors, the results of which revealed, "large differences among teachers in their impacts on achievement and (the results) show that high quality instruction throughout primary school could substantially offset disadvantages associated with low socioeconomic background" (Rivkin, Hanushek, & Kain, 2005, p. 419). In other words, teachers who provide higher quality instruction can counterbalance the negative effects of students from low socioeconomic backgrounds.

To be sure, parents also play a critical role in encouraging their children to act responsibly, complete homework, and work hard in school (White, 2001). "Parents' attitudes, expectancies, and beliefs about schooling and learning guide their behavior with their children and have a causal influence on their children's developing achievement attitudes and behaviors" (White, 2001, p. 38). Involving parents in decisions related to their child's education, although often easier said than done, has a positive effect on student achievement in math (White, 2001). Viewing parents as partners in the educational process requires that teachers have trust in parents.

Educators and parents have a better chance of ensuring students' success if all of these factors are taken into consideration, especially the research about high impact instructional math practices. Grouws and Cebulla (2000) reviewed the current literature to determine which instructional strategies had the greatest positive effect on math achievement. The teaching

practices they identified include: “opportunity to learn (practice), focus on meaning (understanding), problem solving, opportunities for invention and practice (discovery learning), openness to student solutions and student interactions, small group learning (cooperative learning), whole-class discussion, focus on number sense, use concrete materials (manipulatives), and use of calculators” (Grouws & Cebulla, 2000, pp. 1-3).

Math Anxiety

Dreger and Aiken (1957) describe a phenomenon called “number anxiety” which now is known as math anxiety. In her book *Overcoming Math Anxiety* (1993), Tobias describes the concept and its psychological effects on students. Many researchers have defined math anxiety as the feelings of panic, tension or fear of failure that many students, and teachers alike, may experience about mathematics (Wood, 1988; Tobias, 1993). To be clear this type of anxiety is more than a dislike of the subject of math, yet it is a difficult concept to define (Vinson, 2001).

“The ambiguity and lack of consistency with which people use the expression further exacerbates the difficulty of deciding how to measure it or what it is that is actually to be measured” (Wood, 1988, p. 9). Swars and her colleagues found that elementary teachers, like students, also experienced anxiety about math, especially pre-service teachers (Swars, Daane, & Giesen, 2006). Educators with high math anxiety tend to teach in a more traditional, teacher-centered, whole-class instruction manner, rather than integrating learner-centered instructional strategies (Swars, Daane, & Giesen, 2006). Further, there is much discussion about how teachers’ anxiety, or lack of confidence in their knowledge, about mathematics can negatively affect students’ feelings and attitudes about the subject area, especially in elementary school (Wood, 1988; Jackson & Leffingwell, 1999; Swars, Daane, & Giesen, 2006; Ramirez, Gunderson, Levine, & Beilock, 2013).

Geist asserts that students with, “negative attitudes towards mathematics” have what can be described as ‘math anxiety’ (Geist, 2010, p. 24). Many researchers have found that these negative attitudes about math begin as early as kindergarten (Ashcraft, 2002; Popham, 2008; Rameau & Louime, 2007). Students, especially elementary students, experience this type of anxiety which is often “caused by past classroom experiences, parental influences, and remembering poor past math performance” (Scarpello, 2007, p. 35). Students who lack the self-confidence in their ability to perform well in math class may create a self-fulfilling prophecy as a result. In the end, students who are afraid of failing in mathematics may avoid completing math related tasks (Ramirez et al., 2013).

Is math anxiety behavioral or cognitive in nature? Why do students who have had negative experiences with mathematics continue to struggle academically? Researchers offer two models for math anxiety: an interference model and an alternative deficits model (Hembree, 1990; Tobias, 1985). When a student demonstrates the interference model, he allows his anxiety to interrupt his long-term memory and connection to prior learning (Hembree, 1990). Tobias (1985) suggests that the alternative deficits model is exhibited by students who have poor study habits and test-taking skills particularly in the areas of math.

Hembree asserts that when math anxiety is reduced in students, math achievement scores are more likely to increase (Hembree, 1990). “Addressing math anxiety at the teacher level may be an effective starting point in ameliorating math anxiety in young children and improving children’s math achievement” (Ramirez et al., 2013, p. 198). Teachers who are encouraging can influence students by reducing math anxiety (Scarpello, 2007). The use of student-centered learning and manipulatives for elementary students has been shown to be highly effective in improving math achievement (Chavez & Widmer, 1982). As students gain confidence in their

abilities mathematically, student achievement increases, as does their self-efficacy. Chavez and Widmer (1982) discovered that many elementary teachers, “were genuinely eager to create a positive learning climate” (p. 388), in order to overcome student anxiety about math.

Classroom Climate

How can teachers establish a positive classroom climate, promote high expectations of students, and encourage students to work cooperatively within the classroom? Is it possible that a teacher can interpret the climate differently than the students perceive it to be? We believe that a healthy classroom environment is built upon mutual trust and respect. “However, when students and teachers interpret the ‘health’ of the learning environment quite differently, this disparity may negatively impact classroom pedagogy and overall student learning” (Deemer, 2004). Thus, the health of the classroom affects the level of respect, trust, and learning that occurs among teachers and students. An unhealthy environment can negatively impact students for years to come, whereas a healthy environment can make all of the difference in student achievement, self-efficacy and confidence, and motivation to succeed in school (Burnett, 2002; Stuart, 2000.)

Burnett (2002) asserts that student-teacher relationships must be constructive in nature for the classroom climate to be healthy and productive. However, there are many instructional factors that need to be considered in regard to classroom climate and math achievement. “Many teachers struggle with the realization that their classroom contains students with a wide range of skills, but they can only teach to one skill at a time” (Ysseldyke, Spicuzza, Kosciulek, & Boys, 2003, p. 164). Furthermore, teachers may have high achieving students who are uncooperative with low and average achieving students or unmotivated low achieving students (Stuart, 2000).

These type of circumstances can lead to classroom friction, which is reflected in the level of tension or conflict among the teacher and students (Sink & Spencer, 2007). Some friction may be considered normal or healthy, however too much friction can affect the climate of the classroom negatively. Bennett (2001) found that, “in classrooms with reduced friction, there appeared to be a more equal distribution of academic achievement among students regardless of gender or race” (p. 38). Interestingly, Deng (1992) conducted a study, the results of which demonstrated that there were academic differences between male and female students when they perceived more friction in the classroom.

Teacher Trust in Clients – Students and Parents

To develop positive learning environments in classrooms, it is important for teachers to be efficacious about their abilities as educators. Trust has been described as an essential aspect of school effectiveness (Bryk & Schneider, 2002; Hoy & Tschannen-Moran, 1999; Tschannen-Moran, 2009). It is important that teachers have trust in their students and parents because, “the work of schools rests on the establishment of trusting relationships” (Author & Tarter, 2012). Teachers view parents as partners who are also working in the best interest of the students (Forsyth, Adams, & Hoy, 2011; Author & Tarter, 2012). Strong teacher trust in clients “leads to high levels of collective efficacy in schools (in which) teachers come to share the belief that their school can have positive effects on students” (Forsyth, Adams, & Hoy, 2011, p. 89). Most importantly, “trust is a strong predictor of several important outcomes for schools, including student achievement” (Goddard, Salloum, & Berebitsky, 2009, p. 298). Hoy and his colleagues assert, “When students, teachers, and parents have common learning goals, trust and cooperation are likely ingredients that improve teaching and learning” (Hoy, Tarter, & Woolfolk Hoy, 2006, p. 430).

Method

Participants

The authors examined classroom climate data collected during the 2010-2011 school year. During that year, a total of 2,340 4th and 5th grade students completed the My Class Inventory (Fisher, & Fraser, 1981), and 74 4th and 5th grade teachers completed the Teacher Academic Optimism Scale (Hoy, Tarter, & Woolfolk Hoy, 2006). First, all non-math classrooms data were removed. Only math classrooms that had a calculable percentile rank in the state for math achievement on the Texas Assessment of Knowledge and Skills for 2011 were included for analysis. Next, researchers excluded all student data from classrooms which did not have a corresponding teacher survey. This resulted in a total of 482 student surveys with corresponding teacher surveys from 26 different mathematics classrooms, within ten public elementary schools in Texas being selected for statistical analysis. Socioeconomic status (SES) was measured as the percentage of students qualifying for free or reduced-price lunch, which ranged from 10% to 71% for campuses participating in this study.

Instrumentation and Definition of Terms

Teacher trust in clients was measured utilizing the Teacher Academic Optimism Scale for Elementary Teachers (TAOS-E) (Hoy, Tarter, & Woolfolk Hoy, 2006). The TAOS-E is a three-factor instrument that measures teacher self-efficacy, academic emphasis, and teacher trust in parents and students. Sample items from this instrument include statements such as, “I can trust the parents of my students,” and “I have confidence in my students.” Items are measured on a 5 point Likert scale ranging from “never” to “always” (Woolfolk Hoy, Hoy, & Kurz, 2008).

Student perceptions of classroom friction were measured utilizing the My Class Inventory (Fisher & Fraser, 1981). The My Class Inventory (MCI) is a five-factor instrument

that measures friction, cohesion, competition, difficulty, and satisfaction. Sample items from the Friction section of the MCI include, “Students are always fighting with each other,” and “Some students in our class are mean.” Students respond to items by selecting either yes, no, or neither yes or no (Settlage, 2011).

Two control variables are included in this study. The first control variable is the number of years of teacher experience on campus. This variable resides at the classroom level, and was selected based on previous studies that have identified teacher experience as a useful predictor of student success (Ingersoll, Merrill, & May, 2012). The second control variable utilized in this study is socioeconomic status (SES), which was calculated at the school level by utilizing the percentage of students qualifying for free and reduced lunch as a proxy for the socioeconomic states, or wealth of the student population by campus. An overwhelming number of educational studies have identified SES as a strong predictor of student achievement on tests (Books, 2007; Goddard, Salloum, & Berebitsky, 2009; Hoy, 2012; Hoy, Smith, & Sweetland, 2002; Riegle-Crumb & Grodsky, 2010). Thus it was determined that this item would be included as a control variable in order to get a more accurate picture of the factors that influence math achievement.

Math achievement was measured utilizing classroom scale score percentile rank in the state on the Texas Assessment of Knowledge and Skills for the 2010-2011 academic year (Texas Education Agency, 2011). There are inherent difficulties with utilizing Texas state achievement scores, including skewed data (Archer, 2003), and a moving target for passing standards (Mellon, 2010) that some have claimed mirrors election year politics. However, the percentile rank in the state is a measure that is relatively immune from political gamesmanship as the percentile rank in the state remains static regardless of the cut score for passing established by the state.

Data Analysis

Classrooms are nested within schools. This means that it is important to isolate school level factors from classroom level factors that may impact upon student achievement. Three of the independent variables in this study occur at the classroom level: teacher trust in clients, classroom friction, and teacher years of experience on campus, while socioeconomic status occurs at the school level. In the past, social science researchers have aggregated individual level variables to the group level (e.g., district, school, and classroom), however this has the potential to introduce aggregation bias, heterogeneity of regression among groups, and misestimated standard errors (Raudenbush & Bryk, 2002). As a result, the authors determined it was necessary to analyze the data using a multi-level analysis technique, which keeps data at the level in which they naturally reside, which led us to select a two level Hierarchical Linear Model.

First, an estimation of an unconditional or intercept only model was conducted to determine the existence and degree of unexplained variance in math achievement between classrooms. Second, a Level 1 model estimation was completed, which included ratings of teacher trust in clients, classroom friction, and teacher years of experience on campus. Finally, a full Level 2 model estimation followed with socioeconomic status serving as the Level 2 predictor of the intercept and the Level 1 slopes. All variables were treated as continuous.

Results

Descriptive Statistics

Percentile rank in the state for Mathematics ranged from the 37th percentile for the lowest performing classroom to the 81st percentile for the highest performing classroom in this study. Out of the 26 classrooms in this study, 23 classrooms ranked above the 50th percentile, while three classrooms were ranked below the state average.

A total of 482 students from 26 elementary mathematics classrooms (14 fourth grade classrooms and 12 fifth grade classrooms) completed the My Class Inventory, which served as the source of data for Classroom Friction within this study. Classroom Friction averages ranged from a low of 1.42 to a high of 2.58 on a three-point scale. Each of the teachers from the 26 classrooms completed the Academic Optimism Scale (Hoy, Tarter, & Woolfolk Hoy, 2006), which provided information on teacher trust in clients for the purpose of this study. Teacher trust in clients scores ranged from a low of 2.0 to a high of 4.75 on a five-point scale.

The average years of experience on campus for these 26 teachers was 3.73, with the least experienced math teacher having one year of experience, and the most veteran math teacher having nine years of experience on campus. The percentage of students on campus who qualify for free or reduced lunch ranged from 10% for the wealthiest school in this study to 71% for the poorest school in this study (see Table 1).

Variability of Math Achievement between Classrooms

The one-way ANOVA with random effects model (also known as the null or unconditional model) was used to determine the existence and degree of unexplained variance in math achievement between classrooms. Findings indicated that unexplained variation existed in math achievement between classrooms ($\chi^2 = 46.25, p < .001$). The intraclass correlation (ICC), or the ratio of between-group variance to total variance, was .6154, indicating that 61.5% of the overall variation in math achievement lies between classrooms (see Table 2).

One Way ANOVA Model in Equation Format:

Level 1 (Classroom Level):

$$\text{MathAchievement} = \beta_{0j} + r_{ij}$$

Level 2 (School Level):

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

Impact of Classroom Level Factors on Math Achievement

In the random coefficient model, variables at the classroom level were added to the Level 1 equation to assess whether any of these classroom level factors were related to math achievement. The results demonstrate a statistically significant difference in the level of math achievement ($\gamma_{10} = 4.77, t = 1.86, p < .05$), favoring classrooms in which teachers expressed high levels of trust in students and parents. The results also show that classroom friction is a statistically significant negative predictor of math achievement ($\gamma_{20} = -11.50, t = -2.148, p < .05$). However, the number of years of experience teachers had on campus was not a significant predictor of math achievement for the classrooms within this study ($\gamma_{30} = 0.88, t = 0.49, p = \text{n.s.}$). Together, these three factors accounted for 24% of the variance in math achievement (see Table 3).

Random Coefficient Model in Equation Format:

Level 1 (Classroom Level):

$$\begin{aligned} \text{MathAchievement} = & \beta_{0j} + \beta_{1j} (\text{TeacherTrust}) + \beta_{2j} (\text{Friction}) + \beta_{3j} \\ & (\text{YearsonCampus}) + r_{ij}(\text{ResidualUnexplainedVariance}) \end{aligned}$$

Level 2 (School Level):

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

Impact of Socioeconomic Status on Math Achievement

In the intercepts and slopes-as-outcomes model, socioeconomic status at the school level was added to the Level 2 equation to assess whether teacher trust in clients, classroom friction, and teacher years of experience on campus were related to math achievement when factoring in school wealth or Socioeconomic Status (SES). Findings indicated that a statistically significant relationship existed between teacher trust in clients and math achievement regardless of SES ($\gamma_{10} = 4.709, t = 2.66, p < .05$). Findings also indicate that a statistically significant negative relationship exists between classroom friction and math achievement regardless of SES ($\gamma_{20} = -11.37, t = -2.23, p < .05$). However, the years of teacher experience on campus did not make a significant contribution to the variance in math achievement ($\gamma_{30} = 0.50, t = 1.14, p = \text{n.s.}$) (See Table 4).

Intercepts and Slopes as Outcomes Model in Equation Format:

Level 1 (Classroom Level):

$$\begin{aligned} \text{Math Achievement}_{ij} = & \beta_{0j} + \beta_{1j} (\text{TeacherTrust}) + \beta_{2j} (\text{Friction}) + \beta_{3j} \\ & (\text{YearsonCampus}) + r_{ij} (\text{ResidualUnexplainedVariance}) \end{aligned}$$

Level 2 (School Level):

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{SES})_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

$$\beta_{2j} = \gamma_{20}$$

$$\beta_{3j} = \gamma_{30}$$

Discussion

In this study, the unconditional model identifies whether there is a significant difference in the level of math achievement between classrooms. The results of this analysis, known as the intraclass correlation, indicate that, in fact, students do achieve at significantly higher levels in mathematics in some classes than they do in others. The existence of variance at the classroom levels allows us to further examine which classroom level factors may be contributing to this variance.

The random coefficient model explored whether three classroom level factors play a role in determining the level of math achievement. Let's briefly examine each in turn: Teacher trust in students and parents emerged as a significant determinant of math achievement. Similarly, student perception of classroom friction was significantly related to math achievement. However, not all of the variability in math achievement lies between classrooms. Because SES has historically proven to be such a large predictor of student achievement on tests, the authors of this study felt it was important to include SES in the examination in order to report the impact of each independent variable as accurately as possible.

Perhaps not surprisingly, school wealth, or SES, emerged as a strong predictor of student success. After all, school wealth has demonstrated itself to be a strong predictor of student success on tests (Books, 2007; Goddard, Salloum, & Berebitsky, 2009; Hoy, Smith, & Sweetland, 2002; Riegle-Crumb & Grodsky, 2010). Perhaps the most significant finding within our study is that enhanced teacher trust in clients and reduced classroom friction emerged as significant predictors of math achievement, even when factoring in school wealth. This means that classrooms in which teachers expressed high levels of trust in their students and parents along with classrooms that had reduced levels of classroom friction achieved at significantly

higher levels than classrooms with lower levels of trust and/or higher levels of friction. This was just as true in wealthy schools as it was in schools of poverty. In fact, for each one point rise in teacher trust in parents and students, elementary math achievement rose by 4.7% regardless of wealth.

Classroom friction emerged as a significant negative predictor of math achievement for the classrooms in this study. For each one point rise in the level of classroom friction, class average percentile rank in the state declined by 11.4% (again, regardless of wealth). Recall that sample items from this measure included statements such as, “Students are always fighting with each other.” Thus classroom friction appears to be at least in part a measure of the level of disciplinary control exerted (or not exerted) by teachers in the classroom. Teacher trust in clients and student perceptions of classroom friction may in fact be related to one another as well. If teachers are confident in their own instructional and disciplinary abilities, this may help them to trust the students in their classrooms, and allay friction concerns on the part of students. While there may be very little that teachers and administrators can do to improve the wealth of families who attend their school, teacher trust in clients and classroom friction are well within the campus’ locus of control.

Interestingly, the number of years of teacher experience on campus was not significantly related to math achievement. This may be because the range of experience was quite limited for the participants in this study (range of experience = one-nine years (see Table 1)). A larger study with a broader range of teacher experience may shed greater light on this relationship. However, the lack of ability to retain quality math teachers has been documented as a problem nationwide (Ingersoll, Merrill, & May, 2012), so it is also possible that the reason the range of experience

was so limited was because these campuses, like many across the nation, face a high level of attrition of qualified math teachers.

Limitations

Because this study examined only elementary math classrooms in ten public schools in Texas, the generalizability of findings is limited. It may be of value to the field for future research to be conducted in a wider array of classrooms. For example, the authors intend to conduct future research to determine if similar results will be found at the secondary level. It may also be useful to examine whether similar results would be found in different regions of the United States or internationally. Additionally, while this study utilized both teacher and student perceptions of classroom climate, administrator and parent perceptions were not included. It may be interesting for future studies to simultaneously assess teacher, student, parent and administrator perceptions of the climate in math classrooms in order to provide a 360° view of a variety of classroom climate factors and their relationship with math achievement. Another interesting follow up question that was not explored in this study would be – why do some teachers trust their constituents more than other teachers do? It is possible that this trust is related to the teacher's sense of math self-efficacy. Alternatively, teacher trust in clients may be a reflection of the level of order and discipline that the teacher is able to maintain in the classroom. Further study is warranted to examine what may be causing this difference.

Conclusion

Math education is vital to both educational and employment success. Improving math education is a stated goal of both state and federal Departments of Education within the United States. Nevertheless, the U.S. continues to lag behind many other countries in math achievement. Understanding the factors that contribute to math achievement is an essential

component of school improvement efforts. This study isolated two specific classroom climate factors: teacher trust in clients, and classroom friction, in order to determine whether either factor is significantly related to math achievement. For the classrooms participating in this study, both teacher trust in clients and student perceptions of classroom friction were significantly related to math achievement. While these are not the only factors which contribute to student success, increased teacher trust and reduced levels of classroom friction may be one lever that principals and teachers can utilize to increase achievement in elementary math classrooms.

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Table 1: Descriptive Data

	Sample	Mean of Participant Scores / Responses	Range of Participant Scores / Responses	Range of Possible Scores/ Responses	Data Level
<i>Scale Score Percentile Rank in the State for Mathematics</i>	26 math classrooms	61 st Percentile	37 th -81 st percentile	0-99 th Percentile	Level 1 (Classroom level data)
<i>Classroom Friction</i>	482 student respondents	1.96	1.42 - 2.58	1-3	Level 1 (Classroom level data)
<i>Teacher trust in Clients</i>	26 math teachers	3.94	2.0 - 4.75	1-5	Level 1 (Classroom level data)
<i>Years of Teacher Experience</i>	26 math teachers	3.73	1-9	0.1 - ___	Level 1 (Classroom level data)
<i>% of students on campus qualifying for free or reduced lunch</i>	10 elementary schools	38%	10-71%	0-100%	Level 2 (School level data)

Table 2: Math Achievement: Results from the One-Way ANOVA Model

Fixed Effects	Coefficient (SE)	t (df)	p-value
Model for Intercept (β_0)			
Intercept (γ_{00})	62.19 (2.6)	23.78 (9)	<.001
Random Effects (Variance Components)			
	Variance	χ^2 (df)	p-value
Var. in school means, (τ_{00})	53.87	46.25 (9)	<.001
Var. within schools, (σ^2)	33.66		

Table 3: Math Achievement: Results from the Random Coefficient Model

Fixed Effects	Coefficient (SE)	t (df)	<i>p</i> -value
Model for Intercept (β_0)			
Intercept (γ_{00})	58.52 (2.96)	19.76 (9)	<.001
Model for Teacher trust slope (β_1)			
Intercept (γ_{10})	4.77 (1.86)	2.56 (22)	0.018
Model for Class Friction slope (β_2)			
Intercept (γ_{20})	-11.50 (5.35)	-2.15 (22)	0.043
Model for Teacher Years on Campus slope (β_3)			
Intercept (γ_{30})	0.88 (0.49)	1.81 (22)	0.084
Random Effects			
(Variance Components)	Variance	χ^2 (df)	<i>p</i> -value
Var. in school means, (τ_{00})	36.03	41.17 (9)	<.001
Var. within schools, (σ^2)	25.62		

Table 4: Math Achievement: Results from the Intercepts and Slopes-as-Outcomes Model

Fixed Effects	Coefficient (SE)	t (df)	p-value
Model for Intercept (β_0)			
Intercept (γ_{00})	70.42 (3.88)	18.13 (8)	<.001
Socioeconomic Status (γ_{01})	-.29 (.07)	-4.22 (8)	0.003
Model for Teacher trust slope (β_1)			
Intercept (γ_{10})	4.709 (1.77)	2.66 (21)	0.015
Model for Class Friction slope (β_2)			
Intercept (γ_{20})	-11.37 (5.09)	-2.23 (21)	0.036
Model for Teacher Years on Campus slope (β_3)			
Intercept (γ_{30})	0.50 (0.44)	1.14 (21)	0.267
Random Effects (Variance Components)			
Var. in school means (τ_{00})	6.44	12.70 (8)	0.122
Var. within schools (σ^2)	23.14		