The Influence of Collective Efficacy on Mathematics Instruction in Urban Schools

Abstract

Although, researchers have repeatedly demonstrated the positive relationship between collective efficacy and student achievement (e.g., Goddard, 2001; Tschannen-Moran & Barr, 2004), little research focuses on the mechanism of this connection. At the time of this writing, this study is one of the first to examine this association. Insight into how collective efficacy relates to teacher practice can lead to a better understanding of improving instruction, student achievement, and schools in general. In this paper, we explore the relationship between collective efficacy and middle school mathematics instruction in two urban school districts undertaking education reform. Using survey data and video recorded classroom lessons from 109 teachers across 25 schools, we employ multilevel modeling to find a modest and statistically significant relationship between collective efficacy and mathematics instruction, as measured by the Instructional Quality Assessment.

Introduction

American schools are under continual, immense pressure to close the persistent achievement gap between disadvantaged students and their more advantaged peers (e.g. National Assessment of Educational Progress, 2013). In order to narrow these gaps, numerous policymakers and district leaders have sought to improve instruction across whole systems. However, these instructional reform efforts are often ushered in quickly and rarely meet success (e.g., Elmore, 1996; Gamoran et al., 2003). In order for these school reform efforts to make persistent changes in teachers' practice, districts must leverage systematic supports (Cobb & Jackson, 2011) geared towards improving pedagogy. For example, districts might invest heavily in resources and strategies such as curricular materials, ongoing professional development, instructional coaching, or professional learning communities. Many district and school leaders though fail to take advantage of a critical systematic support when adopting reform: collective efficacy.

Emerging from his work on social cognitive theory, Bandura defined collective efficacy as "a group's shared belief in its conjoint capabilities to organize and execute the course of action required to produce given levels of attainments" (Bandura, 1997, p. 477). In the context of elementary and secondary education, does the faculty believe in their motivation and skill to educate all students? School-wide collective efficacy has a consistent link to student achievement above and beyond that of prior performance and socioeconomic status (Goddard, 2001; Goddard, Hoy, & Woolfolk Hoy, 2000; Tschannen-Moran & Barr, 2004; Hoy, Sweetland, & Smith, 2002; Goddard, LoGerfo, & Hoy, 2004; Salloum, under review). Goddard and colleagues (Goddard, Goddard, Kim, & Miller, 2015) extended this line of inquiry by exploring the role that collective efficacy, as well as principal leadership, plays in teachers' instructional improvement efforts. In this paper, we continue this work by directly examining the connection between collective efficacy and instruction. If policymakers and district leaders hope to improve instruction across a system and thereby close achievement gaps, collective efficacy may be a key condition in facilitating support structures. Thus, in this paper, we explore the relationship between collective efficacy and mathematics instruction in two urban school districts undertaking education reform.

Review of the Literature

In this study, we consider the interaction between collective efficacy and classroom instruction. We begin this section by reviewing the literature on collective efficacy through the lens of social cognitive theory and then briefly explore the research linking collective efficacy to student achievement. Next, we employ Cohen and Ball's (1999) instructional framework, which argues that the environment in which instruction is embedded greatly impacts interactions between the teacher, students, and content. Finally, we argue that collective efficacy, as an aspect of the instructional environment, can influence instruction.

What is Collective Efficacy?

Collective efficacy is a group's belief in its capabilities to achieve a common goal. Using social cognitive theory as a framework, Bandura (1997) posits that, "efficacy beliefs influence the degree of persistence and creativity with which individuals and groups approach prospective tasks" (Goddard et al., 2015, p. 507). As a learning theory, social cognitive theory espouses that a person's knowledge and behaviors are heavily influenced by the behaviors and attitudes a person observes around them (Bandura, 1986). In schools, this means that teachers' beliefs and actions are greatly affected by the beliefs and actions of their fellow teachers as well as students, parents, and school leaders. For example, a teacher will be more likely to attempt a new instructional technique if he or she sees the rest of the faculty embrace the new pedagogy.

Bandura (1986, 1997) posited that four differences sources shape all efficacy beliefs: mastery (enacted) experiences, vicarious learning, social persuasion, and affective states, and researchers have shown how these aspects can influence a group's collective efficacy (e.g., Goddard, 2001; Goddard et al., 2015). This emergent group property is more than the sum of its parts as several factors may contribute to collective efficacy: the knowledge and skills of those in the organization; how the organization is managed, structured, and led (Goddard & Salloum, 2012); and relationships and interactions between colleagues (Somech & Darch-Zahavy, 2000; Moolenaar, Sleegers, & Daly, 2012; Berebitsky & Salloum, under review). While a school might be populated with competent teachers, collective efficacy will not characterize the faculty if the teachers do not believe in their collective capability. Whether naturally occurring or engineered, collective efficacy matters to group goal attainment.

When applying social cognitive theory to education, schools with a robust sense of collective efficacy approach difficult tasks as challenges to overcome as opposed to impossible undertakings. Such organizations set high goals for themselves and maintain a strong commitment to meeting these goals. When faced with a setback, highly efficacious teachers are resilient and therefore recover quickly (Gibson & Dembo, 1984).

Teachers in schools with higher levels of efficacy attribute failure to insufficient effort, knowledge, or skill. Research has shown that teachers in schools with higher levels of collective efficacy tend to engage in more reflective dialogue (Lim & Eo, 2014), exhibit more professional commitment (Ware & Kitsantas, 2007), and report greater job satisfaction (Caprara et al., 2013). In comparison, schools with lower levels of collective efficacy tend to shy away from difficult tasks. Organizations with lower efficacy may have modest ambitions and weak commitment to the goals they set. When faced with an impediment, these groups focus on their shortcomings and give up quickly. Because school faculties with low levels of efficacy may attribute poor performance as a deficit in student aptitude, they are unlikely to be as resilient and could quickly lose faith in their capability (Bandura, 1997; Salloum, 2011). Therefore, faculties with similar skill levels but variant levels of collective efficacy may engage students in instruction in fundamentally different ways.

The Relationship Between Collective Efficacy and Achievement

Perhaps the most important reason researchers pursue collective efficacy is the powerful relationship with student achievement (e.g. Bandura, 1993; Goddard, Hoy, & Woolfolk Hoy, 2000). In Bandura's (1993) seminal study, collective efficacy was positively and significantly related to school-level achievement in both mathematics and reading. Multilevel work by Goddard, Hoy, and Woolfolk Hoy (2000) supported and expanded upon Bandura's initial scholarship by establishing a relationship between collective efficacy and individual student achievement in mathematics and reading in urban elementary schools after controlling for race and socioeconomic status. A number of quantitative studies have linked collective efficacy to student performance in elementary (e.g., Goddard, 2001; Goddard, Hoy, & Woolfolk Hoy, 2000), middle (e.g., Tschannen-Moran & Barr, 2004), and high school contexts (e.g., Hoy, Sweetland, & Smith, 2002; Goddard, LoGerfo, & Hoy, 2004). Other researchers have explored this link qualitatively in low socioeconomic (e.g., Parker, Hannah, & Topping, 2006) and international contexts (e.g., Klassen, Chong, Huan, Wong, Kates, & Hannok, 2008). While these studies illustrate the consistent association between collective efficacy and student achievement, few researchers have empirically examined whether or not this is strictly a direct association or whether collective efficacy may influence student learning through some other mechanism. We hypothesize that one potential way that collective efficacy could ultimately affect student achievement is via the core of teachers' work: instruction.

Instruction Defined

At the most basic level, the process of teaching and learning is based on interactions between a teacher and her students around educational materials (Cohen & Ball, 1999). Consistent with this viewpoint, instruction requires all three elements. Figure 1 presents this conceptual model, illustrating the fundamental elements of the classroom ecology: the triad of teacher, students, and content, which is embedded in environments (e.g., Cohen Raudenbush & Ball, 2003; Sizer, 1984). The sides of the triangle indicate three central relationships composing instruction: (1) teacher and student, (2) teacher and content, and (3) student and content. These relationships all take place within environments, which include the social and organizational context of the individual classroom, the school, and influences external to the school. Extensive evidence illustrates that even with similar formal structures and resources, aspects of the school environment, such as collective efficacy, vary across schools (e.g., Goddard, Hoy, & Hoy, 2000; Bryk & Schneider, 2002; Salloum, Goddard, & Larsen, in press). This variance in environments has implications for instruction as teachers and schools may make better or worse use of resources. This model not only illustrates the relational aspects of instruction, rather than instruction as something teachers deliver and students passively receive, but it also depicts the context specific nature of teaching and learning.

Insert Figure 1 about here

Teachers, Students, and Content

"Teachers mediate instruction: their interpretation of educational materials affects curriculum potential and use, and their understanding of students affects students' opportunities to learn" (Cohen & Ball, 1999, p. 4). Teachers' intellectual and personal resources influence how teachers make sense of materials and students. Teacher resources include their understanding of content, conceptions of knowledge, relational skills with students, and more; these resources mediate how teachers shape instruction. First, the teacher has a relationship to the curriculum, and her knowledge of the subject matter needs be deep and flexible in order to connect ideas to one another, to address student misconceptions, and build on students' ideas to maximize student learning. She also needs to understand subject matter across fields, and the ability to connect content to everyday life. This understanding of content as well as curricular development is known as pedagogical content knowledge (Shulman, 1986, 1987). The teacher also has a relationship with her students; the teacher needs to know her students as individuals, as members of a group, and as learners. While the teacher thinks about the individual needs of each student, she also considers the needs of the group as a whole. Finally, while managing students as individuals, the teacher must also manage the interactions of students with one another. Students – and interactions among students – also shape the resources for their own learning. Students' experiences, prior knowledge, motivation, and engagement are also important to instruction. Interactions between students can influence the relationship to content knowledge. Content is anything with which students engage: texts, media, technology, tasks, problems, and questions posed.

Of course all models are often simplified representations, failing to adequately capture the interactive dynamics between people. Impediments reside in the number of arrows depicting interaction among individual students, as well as teacher relationships with groups. Teachers typically do not interact with only one student at a time, but rather with groups of students or with an entire class (Lampert, 2001). Even when working with an individual, a teacher's interaction generally occurs with the other students witnessing the communication. Despite the social dynamic limitations, the utility of this model is to illustrate the main purpose of instruction: the teacher's responsibility to connect students to content knowledge. However, the facilitation of that relationship not only hinges on the teacher's own relationship to content and her relationship with students, but also embedding all these relationships within a productive environment.

High Quality Instruction

Both districts studied in this project, described in detail in the Methods section, sought to improve middle school mathematics by aligning instruction with the recommendations of the National Council of Mathematics Teachers (2000). These recommendations advocated for all teachers to implement cognitively challenging tasks in their classrooms. "*Cognitively challenging tasks* provide students opportunities to engage in problem solving, thinking and reasoning, and/or developing an understanding of mathematical ideas, procedures, and formulas (Stein, Grover, & Henningsen, 1996)" (Boston & Wilhelm, 2016, p. 6). However, it is not enough for a teacher to simply include cognitively challenging tasks in her lessons, how she implements the task is paramount. The cognitive demand of a task can be reduced if a teacher removes students' opportunities to engage with the task by over-scaffolding or limiting student discussion and voice (Stein et al., 1996; Boston & Wilhelm, 2016). For this study, we define high quality instruction as ambitious classroom practices (Franke, Kazemi, & Battey, 2007; Lampert, Beasley, Ghousseini, Kazemi, E., & Franke, 2010) that employ cognitively challenging tasks and implement them in such a way to maintain the cognitive demand throughout the lesson.

The Role of Collective Efficacy in Instruction

Any factor influencing student behavior can deeply affect development, as people are partly a product of their environment. The school environment, shaped primarily by the adults in the building, has consequences for student learning. Social cognitive theory, which espouses reciprocal causation among the self, environment, and behavior (Bandura, 1977, 1986, 1997), can inform understanding of the setting in which instruction occurs. The task of creating productive environments rests profoundly on teacher skill. While teachers harmonize their individual efforts with the work of others, they are simultaneously affected by what goes on in the classroom and the beliefs, motivation, and performance of their coworkers. Teachers are influenced by the dispositions of their colleagues, as group beliefs have an association with individual attitudes (Goddard & Goddard, 2001). It is easier for a teacher to remain upbeat and positive in a constructive work environment as opposed to a negative one. Moreover, teachers both contribute to and are influenced by collective efficacy in their schools. Collective efficacy beliefs can shape instruction by influencing teachers' relationship with both students, content, and the choice of activities she implements to facilitate students' interactions to content.

Despite our theoretical rationale for the relationship between collective efficacy and instruction, at the time of this writing, we could not locate existing research on this relationship. However, such examples exist within the literature on related concepts such as teacher efficacy and school culture more widely. In a foundational study, Gibson and Dembo (1984) affirmed such an association by comparing the classroom behavior of teachers with high and low levels of self-efficacy. The researchers noted several differences in instructional behavior; teachers with low efficacy were less likely to persist in failure situations and were more likely to criticize students, as compared to teachers with higher levels of efficacy. Furthermore, Allinder (1995) learned that teachers with high levels of self-efficacy developed challenging activities to help students succeed and set more ambitious end-of-year goals for their students as compared to teachers with lower levels of self-efficacy. These studies provide limited evidence that self-efficacy influences instructional practice.

A study by Brown and Medway (2007) considered the confluence of school climate, teacher beliefs, and instruction in an effective school serving under-resourced students. While this case study did not quantitatively link measures of school culture to instruction, it provided an illustration of an exemplary school with a positive and academically focused environment using more constructivist approaches to teaching and learning. Given that this is a single case, more robust quantitative studies are necessary to make this link.

Rationale for Hypotheses

The purpose of this paper is to more fully examine the association between collective efficacy and instruction. As argued in this paper, collective efficacy has the potential to influence the environment in which instruction is embedded. When teachers are characterized by a robust sense of purpose, informed by their colleagues, they are more likely to facilitate positive instructional experiences for their students. Therefore, we hypothesize that collective efficacy will have a positive and statistically significant impact on instruction, measured by the Instructional Quality Assessment (Matsumura et al., 2006) as described below. We acknowledge the reciprocal nature of this relationship – whereby higher quality instruction might also build collective efficacy. For the purpose of this paper, we consider the collective efficacy as a predictor of instruction though it is plausible that high quality instruction might also have an impact on collective efficacy as an outcome. In other words, in this study we examine the relationship between collective efficacy and instruction. The previous discussion leads us to the research question: Is there a relationship between collective efficacy and the quality of mathematics instruction, as operationalized by the IQA, in schools engaged in mathematics reform?

Method

Data

In this study, we analyzed data collected as part of a larger study of middle school mathematics instructional improvement in two large, urban districts. A central goal of the larger study was to understand how districts and schools could best support high-quality mathematics instruction aligned with the recommendations of the National Council of Teachers of Mathematics (2000). The recommendations are consistent with ambitious mathematics practices (Lampert et al., 2010) that are characterized by teachers supporting students to engage in cognitively demanding tasks (Stein, Smith, Henningsen, & Silver, 2000), teachers pressing students to make connections and provide evidence for their reasoning (McClain, 2002), and teachers facilitating whole-class discussions that build on student thinking (Franke et al., 2007). In order to assist teachers in the development of these inquiry-oriented instructional practices, both districts implemented a number of supports including instructional coaches, professional development, and curricular materials.

Our sample consisted of 25 schools split between the two districts, which we refer to as District B and District D. Located in a southern state, District B served over 80,000 students with the majority identifying as ethnically Hispanic (nearly 60%). Over 75% of the students were economically disadvantaged. District D served over 94,000 students in a Midwestern state. Nearly 52% of their student body identified as White, and roughly

63% of the students were eligible for free/reduced price lunch. The 12 schools in District B and 13 schools in District D were selected in consultation with district leaders to reflect variation in each district on student demographics, past academic performance, and capacity for improvement.

Within each of the 25 schools, all mathematics teachers and administrators dealing with mathematics (i.e., all principals and any assistant principal overseeing the mathematics department) were sent an online survey that included the collective efficacy measure. In total, 365 surveys were sent electronically to each respondent's school email, and after six weeks, those that had not completed the electronic survey were sent a paper copy to complete. Of the potential respondents, 20 chose not to participate in the study, which gives us a response rate of 94.5%. In addition, approximately five teachers in each school were randomly sampled to have one of their mainstream (i.e., not Honors and not remedial) student classes videotaped. The random sampling of the teachers helped to control for differences between classrooms.

After eliminating teachers with missing data, 109 teachers across the 25 schools comprised our sample. The number of teachers ranged within each school from a minimum of 2 teachers to a maximum of 7. The mean number in each school was 4.36 with a standard deviation of 1.15.

Measures

To explore the relationship between collective efficacy and teachers' instruction, we investigated two sources of data collected from middle school mathematics teachers: an online survey and a video recording of mathematics instruction.

Collective Efficacy. All mathematics teachers were asked to assess the level of collective efficacy in their school using a slightly modified version of the standard 12-item scale (Goddard, 2002). An important tenet of measuring efficacy beliefs is that the questions are both “task-and situation-specific” (Pajares, 1996, p. 1). As this study focuses exclusively on middle school mathematics teachers and their instruction, the efficacy items were modestly modified to specify “mathematics teachers” instead of “teachers” in items such as, “Mathematics teachers in this school are able to get through to difficult students.” To ensure that the modified items behaved in a similar manner, we conducted an exploratory factor analysis, and the resulting factor structure demonstrated the items correlated similarly to the established scale (all twelve items and associated loadings can be seen in Table 1). The strong reliability of our measure (Cronbach’s alpha = 0.86) was consistent with Goddard’s (2002) 12-item measure.

Insert Table 1 about here

Instructional Quality Assessment. To measure teachers’ enactment of instruction consistent with district reform efforts, teachers were video recorded over two consecutive days during consistent class periods. For the observations, teachers were asked to provide students with a cognitively demanding task and facilitate a whole-class discussion. Thus, the video recorded lessons were not meant to measure teachers’ routine practice, but instead, the potential of the teacher to meet the instructional reform goals of the districts: cognitively challenging mathematical tasks implemented by teachers to maintain the cognitive demand.

The video recorded lessons were coded using the *Instructional Quality Assessment* (IQA; Crosson et al., 2003; Boston, 2012), which focuses on the cognitive demand of the lesson activity and the quality of the whole-class discussion. We chose the IQA because the instrument attends to how teachers enact inquiry-oriented mathematics instruction by maintaining the high-level cognitive demand of their mathematical tasks throughout their lessons. Specifically, the IQA contains multiple rubrics on two dimensions of instruction: Academic Rigor and Accountable Talk. The Academic Rigor rubrics focus on the cognitive demand for students during the mathematics lesson, and the Accountable Talk rubrics center on teacher and student discourse during whole-class discussion. The developers established reliability and validity of the rubrics (Boston & Wolf, 2006; Matsumura et al., 2008) with a Cronbach's alpha of 0.89 and an overall inter-rater agreement of 82%.

For our study, raters were trained to use the IQA rubrics and achieved at least 80% reliability on previously coded videos prior to actual coding. Each rater received a random set of videos to code, and to maintain inter-rater reliability, approximately 15% of the videos were double coded. The raters had an inter-rater reliability across all rubrics of 73.25%. Scores from the IQA rubrics for the two days were aggregated to create a single score, and this overall score was standardized (M=0, SD=1) in analyses. While combining scores for the individual rubrics may mask some variation in instructional quality within teachers, we felt that an omnibus score was appropriate for this exploratory analysis that is focusing on a teacher's overall ability to enact instruction aligned with the NCTM guidelines. Teachers without IQA scores were excluded from the final analyses.

Controls. In this analysis, we included control variables at both the teacher and school levels that have the potential to influence the relationship between collective efficacy and instructional quality. At the teacher level, we accounted for whether or not the teacher had a master's degree, the teacher's experience in mathematics classrooms (measured as years experience teaching mathematics), and the teacher's mathematical knowledge for teaching (MKT). We included these controls because teachers' experience, education-level, and mathematics knowledge could influence their ability to enact inquiry-orientated instruction. MKT was assessed using a paper-and-pencil assessment from the *Learning Mathematics for Teaching* (LMT) project (Hill et al., 2004). Specifically, we employed two test sections (1. number concepts and operations and, 2. patterns, functions, and algebra) to assess teachers' understanding of middle school mathematics content and their ability to handle the situations that arise specifically in teaching middle school mathematics (e.g., assessing student work, representing mathematical ideas, explaining common mathematical procedures) (Ball, Thames & Phelps, 2008). Teachers' raw scores from the assessment were translated into scale scores based on Item Response Theory data from the developers (for more detailed information, see the LMT website at http://www.umich.edu/~lmtweb/). For our analyses, we included an average of teachers' scores from both test sections.

To meet the needs of students from various backgrounds, teachers may adapt their instruction. In order to understand these patterns, at the school level, we accounted for student demographics with controls for the percent of students of color and the percent of students eligible for free/reduced price lunch (FRL). We also included a district dummy variable to account for any systematic differences between the two districts not captured in our control variables.

Analysis

To address our research question on the relationship between collective efficacy and IQA, we employed multilevel modeling, which is appropriate given that collective efficacy was measured at the school level, and a teacher's potential to deliver inquiry-oriented instruction was measured at the teacher level. Further, multilevel modeling allowed us to account for the natural nesting of teachers within schools. Specifically, we employed the xtmixed function in STATA to estimate the following model.

Level 1 Model, Teacher Level

$$IQA_{ij} = \beta_{0j} + \beta_{1j}MKT + \beta_{2j}Years\ Experience + \beta_{3j}Master's + r_{ij}$$

Level 2 Model, School Level

$$\beta_{0j} = \gamma_{00} + \gamma_{01}CE + \gamma_{02}\%FRL + \gamma_{03}\%Minority + \gamma_{04}DistrictB + u_{0j}$$

Our final model includes 25 schools and 109 teachers. As mentioned above, the number of teacher per school varied from a low of 2 teachers to a high of 7. Only one school had the minimum of 2 teachers, and the great majority of schools had at least 4 teachers with complete data. The mean number in each school was 4.36 with a standard deviation of 1.15. The small number of teachers in a few schools is not optimal for multilevel modeling; however, it was important to model the relationship of the school level collective efficacy to teacher level instructional quality even with the sample size concerns.

Results

To create the measure of collective efficacy in schools, each of the twelve survey items was aggregated to the school level, and then we employed principal axis factoring to create a single measure. The items behaved similarly to previous uses of the collective efficacy scale (e.g., Goddard, 2002) as the items loaded on a single factor with a Cronbach's alpha reliability of 0.86. Loadings can be found in Table 1.

Our study sampled 109 teachers in 25 schools across two large, urban districts. School and teacher level descriptives can be found in Table 2. Collective efficacy was standardized to a mean of 0 and standard deviation of 1 to ease interpretation. Across the 25 schools in our sample, collective efficacy ranged from -1.57 to 2.29. The average school in our sample had 74% of students eligible for FRL, and across the sample, the percent ranged from approximately 24% up to 96%. High levels of poverty characterized the majority of schools with only four schools having less than 50% of FRL students. The 25 schools also had, on average, high proportions of students of color with an average of 69% and a range of 31% to 99%. Like the percent of FRL students, the percent of students of color was high in most schools as only six schools had a percentage below 50%.

As discussed in the methods section, we aggregated scores from the IQA rubrics on both days of observation to create a single score for the teacher, which was then standardized. The distribution of teachers shows a relatively normal distribution ranging from -2.80 to 2.57. The average teacher in our study had just over 7.5 years of experience in mathematics classrooms, however, our sample included first year teachers as well as those with over 30 years experience. Of the 109 teachers, 51% held a master's degree. Like collective efficacy and IQA, teachers' MKT scores were standardized to have a mean of 0 and a standard deviation of 1 to ease interpretation.

Insert Table 2 about here

To address our research question, we conducted a multilevel model with teachers nested in schools. The outcome was the standardized IQA scores for each teacher. At the teacher level, we controlled for whether or not the teacher held a master's degree, the teacher's years experience as a mathematics teacher, and the teacher's MKT. At the school level, our main variable of interest is the level of collective efficacy in each school, and we also included controls for which district the school was in (District D is the reference group), the percent of students eligible for free/reduced price lunch, and the percent of students that identify as a student of color.

Prior to conducting our multilevel model, we conducted correlation analyses at the school and teacher levels. As shown in Table 3, the percent of FRL students and percent of students of color correlated highly ($r=0.68$, $p<.01$). Each of these demographic measures correlated significantly and negatively with the level of collective efficacy in the school ($r=-.53$, $p<.01$ for percent of FRL; $r=-0.55$, $p<.01$ for percent of students of color). At the teacher level (see Table 4), IQA was not significantly correlated with years experience or MKT. In addition, we conducted an independent samples t-test comparing teacher performance on the IQA by whether or not they had a master's degree. Results showed a significant mean difference of 0.44 ($t=-2.37$, $p<.05$) as teachers with a master's degree tended to have higher IQA scores than teachers without.

Insert Tables 3 and 4 about here

Results of the multilevel model can be found in Table 5. The multilevel model shows that the level of collective efficacy and instructional quality were significantly and positively related when controlling for variables at the teacher and school levels ($b=0.23$, $p<.05$). For a one standard deviation increase in the level of collective efficacy in a school, teacher's IQA score tended to increase by 0.23 standard deviations. In other words, teachers in schools with higher levels of collective efficacy tended to display teaching practices more in line with the inquiry-oriented instruction measured by the IQA rubrics. In addition, teachers in schools with higher percentages of students of color had, on average, lower IQA scores ($b=-0.02$, $p<.05$). Interestingly, teachers in schools with higher percentages of FRL students tended to score higher on the IQA ($b=.02$, $p<.05$). This counterintuitive finding may arise from the multicollinearity of variables in the model; the high correlation between percentage of FRL and percentage of students of color ($r=0.68$, $p<.001$) indicates probable multicollinearity, which most likely explains the small positive relationship. There was no significant difference between the two districts on IQA performance.

Insert Table 5 about here

At the teacher level, the only variable with a significant association with IQA was whether or not the teacher had a master's degree ($b=0.44$, $p<.05$). The results indicate that teachers with a master's degree tended to better enact the mathematical practices of inquiry-oriented instruction measured by the IQA. Neither MKT nor years experience as a mathematics teacher had a significant relationship with IQA.

Discussion and Conclusions

As revealed in our review of the literature, there is extensive research linking collective efficacy to student achievement. In particular, when high levels of collective efficacy characterize a school environment, student achievement tends to be higher (e.g. Bandura, 1993; Goddard, Hoy, & Woolfolk Hoy, 2000). However, little research focuses on how exactly this school-wide belief can influence student performance. At the time of this writing, this study is one of the first to examine the association between collective efficacy and the quality of instructional practice. Insight into how collective efficacy relates to teacher practice can lead to a better understanding of improving instruction, achievement, and schools in general.

To summarize our findings, in 25 urban middle schools embedded in two districts, there is a modest and statistically significant relationship between collective efficacy and the potential for high-quality mathematics instruction, as measured by the IQA. In other words, when teachers in schools believe in their conjoint capabilities to successfully educate students, there is evidence of more inquiry-oriented instruction in middle school mathematics classrooms. Also of note, we found significant relationships between aggregated student demographics and the quality of mathematics instruction. In addition, teachers who held a master's degree tended to enact instruction that was more inquiry-oriented as captured by the IQA.

Based on the Cohen and Ball (1999) model, instruction is the interaction between teachers, students, and content. These relationships are either facilitated or impeded by the wider educational environment; collective efficacy is part of that educational environment. Often this environment is left unconsidered when educational reform initiatives are implemented. The findings of this study are important because collective efficacy, while a stable property, is also malleable. When considering the application of our findings to practice, we suggest that whenever instructional improvement initiatives are considered that school and district leaders attend to collective efficacy.

One way leaders can improve collective efficacy is by concentrating on the sources of these beliefs as described by social cognitive theory (Bandura, 1997). Faculties need to have mastery experiences to bolster collective efficacy. Instructional success within a grade level, department, or school-wide could contribute to collective efficacy. Learning from peers vicariously is another way to improve collective efficacy. District officials might be thoughtful about how to provide vicarious learning experiences to faculty. Visits to other schools, opportunities to collaborate across the district, professional developments opportunities and the like could provide the opportunity to see success in other environments and see that success is possible in their own schools. Leaders play an important role in improvement efforts, as they are a main source of verbal persuasion. Such leaders can help faculties see that they are capable of implementing reform initiatives to improve instruction. Leaders also have the propensity to impact the affective state. The way in which district officials make decisions and communicate decisions to teachers, can contribute to feelings of anxiety, enthusiasm, desire to take risks, resilience, and more. Improve collective efficacy in these ways will not necessarily solve problems on its own, but it is one of the many levers that school and district leaders can use in school improvement efforts.

Future Research

Given the lack of research into collective efficacy and its association to instruction, this study makes a contribution to the literature by providing an early exploration of the relationship between collective efficacy and instruction. However, further research is still necessary to better understand the relationship discerned here. Researched might gather and analyze longitudinal data to see how changes in teachers' collective beliefs about their capacity to successfully educate students associates with changes in instructional practice. Our current analysis does not allow us to discern the direction of the relationship between collective efficacy and instruction. Increasing collective efficacy could improve instruction. It is also possible that higher quality instruction is associated with increased collective efficacy. In other words, the relationship is likely bidirectional and disentangling directionality is difficult. While the IQA provides a measure of instructional quality in mathematics, it is limited. The IQA only measures certain aspects of instruction, and our use of a combined score across rubrics could mask nuances to the relationship between efficacy and instruction. Additional studies should delve more deeply into different instructional actions enacted by teachers. In this study, instruction was observed on two consecutive days and focused on teachers' potential to enact reform-oriented instructional practices. Therefore, future researchers might employ qualitative techniques or collect additional quantitative observations to understand the routine practice in schools with varying levels of collective efficacy.

Implications for Policy

The findings of this study illustrate that policies supporting collective efficacy in schools needs to be considered. Given the inherent difficulties in improving instruction at scale (Elmore, 1996; Cobb & Jackson, 2011), a great deal of time, effort, and resources must be targeted to see change. Implementing inquiry-oriented instructional practices is not simply a process by which teachers are shown the new pedagogy, and they can automatically enact these practices with high quality. Instructional reform requires extensive and systematic efforts across an entire system. First and foremost, teachers need to buy in to the new method as a viable alternative to traditional measures. Further, actors at all levels need to be committed to the work, to understand the context, to provide feedback, to believe that the reform is worthwhile, and ultimately that the district or school is capable of the reform.

This study indicates that attention must also be paid to the collective efficacy of teachers. Undertaking the transformation of instruction across a whole school requires a belief not just in oneself, but also in one's colleagues. Teachers may be unwilling to step out on a limb with a pedagogical reform if they do not believe that their colleagues are willing and able to step out on the same limb. Moreover, if teachers do not believe that their colleagues can or will implement changes in their instructional practices, then it is unlikely they will put in the extensive effort to transform their own practice.

Limitations

Like all studies, there are limitations to this work. First, we cannot make any causal claims about the relationship between collective efficacy and instructional practices. Given the cross-sectional nature of our data, we do not know how changes in collective efficacy over time might lead to changes in inquiry-oriented instruction. Second, our sample is limited. The cost of both observing classrooms within schools and collecting data across schools can be quite high on a large scale, and these costs, as well as the difficulty of gathering complete, valid data, led to a sample with some small within-school samples. We believe that this study represents a good first step in illuminating this relationship, and future research should pursue even richer samples. Third, our sample is focused on schools within two specific school districts. These schools and districts do not necessarily resemble schools and districts throughout the United States, and therefore, the generalizability of these findings are limited. Finally, we were not able to fully explore how instructional practices mediate the relationship between collective efficacy and achievement. The relationships among efficacy, achievement, and instruction are likely complex, and many other variables potentially play a significant role in the relationship. Understanding how other variables mediate the relationships, or whether other variables serve as mechanisms for the influence of collective efficacy on student learning, is paramount. Future researchers should address this need.

Table 1. Collective Efficacy Factor Loadings (n = 25 schools)

Item	Factor Loadings
Our students come to school ready to learn.	0.77
The opportunities in this community help to ensure that our students will learn.	0.65
Math teachers here are confident they will be able to motivate their students.	0.81
Students here just aren't motivated to learn. [a]	0.65
Home life provides so many advantages the students here are bound to learn.	0.51
Drug and alcohol abuse in the community make learning difficult for students here. [a]	0.44
Math teachers in this school are able to get through to difficult students.	0.73
Learning is more difficult at this school because students are worried about their safety. [a]	0.43
If a child doesn't want to learn, teachers here give up on him or her.[a]	0.67
Math teachers in this school do not have the skills to deal with student disciplinary problems. [a]	0.80
Math teachers in this school really believe every child can learn.	0.68
Math teachers here don't have the skills needed to produce meaningful student learning. [a]	0.55

[a] Items were reverse coded.

Table 2. Teacher and School Level Descriptives (n=109 teachers, 25 schools)

	Mean	SD	Min	Max
Teacher Level				
IQA[a]	0.00	1.00	-2.80	2.57
MKT[a]	0.00	1.00	-2.75	3.10
Master’s	0.51	--	0	1
Math Years Exp.	7.63	7.96	1	34
School Level				
Collective Efficacy[a]	0.00	1.00	-1.57	2.29
% FRL Students	74.23	18.41	23.90	96.42
% Students of Color	68.91	23.67	31.29	98.53

a. Variable has been standardized to a mean of 0 and standard deviation of 1 to ease interpretation.

Table 3. School Level Correlation Matrix (n=25 schools)

	CE	% FRL	% Students of Color
CE	1	--	--
% FRL	-0.53**	1	--
% Students of Color	-0.55**	0.68***	1

~ p<.10, * p<.05, ** p<.01, *** p<.001

Table 4. Teacher Level Correlation Matrix (n=109 schools)

	IQA	MKT	Years Exp.
IQA	1	--	--
MKT	0.10	1	--
Years Experience	-0.03	0.10	1

~ p<.10, * p<.05, ** p<.01, *** p<.001

Table 5. Multilevel Regression with Standardized IQA as Outcome (n=109 teachers, 25 schools)

	Coefficient	SE
Teacher Level		
MKT[a]	0.19	0.13
Math years experience	-0.01	0.01
Master's	0.44*	0.21
School Level		
Collective Efficacy[a]	0.23*	0.10
Percent FRL Students	0.02*	0.01
Percent Students of Color	-0.02*	0.01
District B	0.66	0.45

~ p<.10, * p<.05, ** p<.01, *** p<.001

a. Variable has been standardized to a mean of 0 and standard deviation of 1 to ease interpretation.

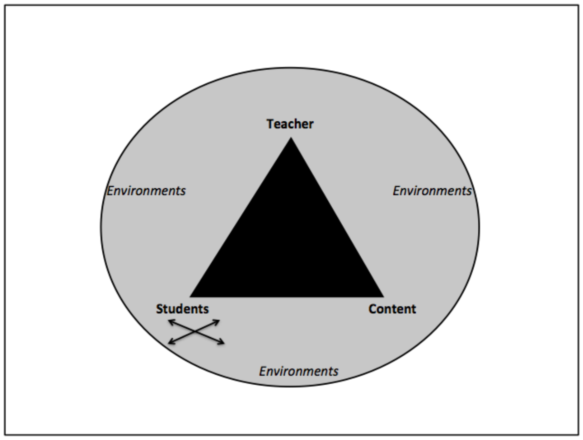

Figure 1. Model of Instruction Adapted from Cohen and Ball, 1999

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