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# Brokering Mathematics Reform: How Principals in Predominantly Hispanic-Serving Schools Conceive of Their Leadership Roles in the Implementation of a District-Wide Mathematics Reform Initiative

Barbara Trujillo

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**Brokering Mathematics Reform:  
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Mathematics Reform Initiative**

**BY**

**BARBARA B. TRUJILLO**

B.S., Education, The University of New Mexico, 1972  
M.A., Special Education, The University of New Mexico, 1981

DISSERTATION

Submitted in Partial Fulfillment of the  
Requirements for the Degree of

**Doctor of Philosophy  
Teacher Education**

The University of New Mexico  
Albuquerque, New Mexico

**July, 2010**

## DEDICATION

I dedicate this dissertation to my family, especially to:

my father, Llewellyn Jones, for his inspiration throughout my life and career;

my mother, Jean S. Jones, for encouraging me and for forgiving my absence;

my sister, Susan, for editing and for supporting me through the long days;

and especially to my beautiful daughter, Michelle, for her wit and patience and pride.

I also thank my dear friend, Jim Fries, for believing in me and seeing me through the greatest challenges.

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**ABSTRACT**

Mathematics reform efforts have been of interest to educational researchers for many years, particularly since the first *Curriculum and Standards for School Mathematics* over twenty years ago. Yet, despite efforts to improve the teaching and learning of mathematics for all students, many students, particularly poor and minority students, still do not have access to instructional practices that allow them opportunities to learn important mathematics. Researchers have called this a problem of scale (Cobb & Smith, 2008), and have begun to consider the important role of the principal in scaling up the reforms.

This qualitative cross-case study investigated the conceptions of three principals in predominantly Hispanic-serving schools as they consider their leadership role in implementing district-adopted mathematics reform initiatives. While there have been a small number of important studies focused on principal leadership and mathematics reform, and studies on principal leadership and policy initiatives, this study is an attempt to bridge policy

and practice. The research considers the combined influences of principals' leadership content knowledge (Stein & Nelson, 2003), their school contexts, and district policies on their ideas about effective leadership of mathematics reforms. In addition, the research expands the construct of leadership content knowledge to consider each of the National Council of Supervisors of Mathematics (NCSM) Prime Leadership Principles of equity, teaching and learning, curriculum, and assessment.

Over a period of two school years, six individual interviews were conducted with each principal. In addition, the researcher joined the principals as they conducted observations of mathematics lessons. Focus interviews, conversations with district personnel, researcher memos, and district/school documents provided further data. The data was analyzed first as individual cases to learn the conceptions of each principal. Then the data was analyzed across cases to look for common themes and insights. Findings showed that principals' ideas about leading mathematics reform in their schools were manifestations of their leadership content knowledge in mathematics, their brokering of district policies related to accountability, curriculum and supervision, and the dynamics within their individual school contexts.

Because the variables that impact principals' sense-making about leading mathematics reform are so complex, none of the principals had set a clear direction for the reforms, and the necessary support for teachers to learn new curricula and new pedagogy was weak. At the end of two years, the principals continued to describe highly variable mathematics teaching in their schools.

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## Chapter 1: Introduction

The teaching and learning of mathematics has been the focus of national reform efforts for over twenty years. Recognizing the need for all students to learn about important mathematical concepts and processes with understanding, the National Council of Teachers of Mathematics (NCTM) enlisted professionals from “diverse expert communities” to develop curriculum standards for school mathematics in an attempt to “develop and articulate explicit and extensive goals for teachers and policy makers” (NCTM 2000, p. ix.). Yet “despite the concerted efforts of many classroom teachers, administrators, teacher-leaders, mathematicians and policy makers” (NCTM 2000, p. 5) and despite the fact that most districts across the country have standards for the teaching and learning of mathematics that are based on the NCTM standards, many students still do not have access to the kind of instructional practices that allow them the opportunity to learn important mathematics (National Research Council, 2001).

Along with calls for changing how mathematics is taught, come calls for changes to address the “opportunity gap” (Flores, 2007; Fry & Gonzales, 2008) so that all students can have access to higher-level mathematics. As articulated in the 2000 *Principles and Standard for School Mathematics* (NCTM 2000), the Equity Principle emphasizes high expectations, challenging curriculum and high-quality instructional practices for all students. Yet closing the opportunity gap for students of color and for students living in poverty has been illusive.

While research has certainly highlighted situations of mathematics teaching that are successfully connecting traditionally underserved populations to rigorous mathematics (see Boaler, 2004; Cohen & Ball, 1999; Kitchen, Dupree, Celedón-Pattichis & Brinkerhoff, 2007), these classrooms are often only “pockets of excellence” (Cobb & Smith, 2008). In fact,

research has shown that the variations in teaching pedagogy and in learning outcomes for students are often greater *within* schools than *between* schools (Hannaway, 2009; Newmann, King & Youngs, 2000). Some researchers are beginning to look at what it will take to improve mathematics teaching and learning at scale (Carpenter et al., 2004; Cobb & Smith, 2008; Spillane, Reiser & Reimer, 2002). Central to the conversation is the role of principal leadership. This research study is interested in exploring the role principals play in leading the reforms in their schools.

### **The Research Question**

- How do principals in predominantly Hispanic-serving schools conceive of their leadership roles in the implementation of a district-wide mathematics reform initiative?

### **Rationale**

**Why principals?** Principals are “street-level bureaucrats” (Lipsky, 1980, p. 13) who stand at the intersection of powerful mandates to improve student performance in mathematics and significant reforms in classroom teaching practices that often take time to change. Lipsky coined the term to suggest that policy implementation, in the end, comes down to the people actually implementing it. He also suggests that principals, by virtue of their supervisory roles, possess a significant degree of discretion in the implementation. Thus, principals “serve as critical links between the district and the school for developing and implementing solutions to identified problems” (Rorrer, Skrla, & Scheurich, 2008, p. 308). Brokering the NCLB (2002) accountability demands and transforming teaching pedagogy to comply with research-based reform practices requires leaders to both “conceive of the reforms and act to support them” (Nelson & Sassi, 2005). This study seeks insights into what three elementary principals conceive of both as possible and as challenging in their unique

schools as they strive to improve mathematics teaching and learning for their predominantly Hispanic students.

A comprehensive review of the research on school leadership, commissioned by the Wallace Foundation, found that among school related factors “leadership is second only to classroom instruction among school related factors in its impact on student learning” (Leithwood, Luis, Anderson & Wahlstrom, 2004, p. 3). Furthermore, researchers studying school improvement have found that without a strong leader present to guide and maintain high expectations in the difficult work of changing a school’s culture, significant obstacles to improvement were insurmountable (Cobb & Smith, 2008; Duke, 2004). To affect reform, the principal’s role is situated in a transformational leadership praxis that is most effective when it includes the following: the effective use of data to inform change, provision of sustained collaborative professional development with targeted support, the skill to “press” or to hold teachers accountable to apply professional learning, the ability to model best practices of inquiry, and the creation of an environment of intellectual stimulation where teachers are encouraged to explore and challenge ideas about teaching and learning (Burch & Spillane, 2003; Nelson & Sassi, 2005; Spillane & Zeuli, 1999; Stein & Nelson, 2003).

Recent research has shown administrators’ understandings of standards-based mathematics instruction and of how they can support it is tied to their own ideas about the nature of mathematics teaching, learning, and assessment (Burch & Spillane, 1999; Nelson, 1998; Spillane, 2002; Spillane & Zeuli, 1999; Stein & Nelson, 2003). While there is significant research that studies the changes in *teachers’* beliefs about the teaching and learning of mathematics as they shift their approach to a more problem-solving view (e.g. Fennema & Franke, 1992; Franke, Carpenter, Fennema, Ansell & Behrend, 1998; Van de

Walle, 2004), I have found only a small body of current research giving insights as to what principals believe as they explore new ideas about mathematics teaching and learning (Buonopane, 2006; Nelson, 1998; Nelson & Sassi, 2005; Stein & Nelson, 2003). This research provides evidence that administrators, too, need opportunities for “conceptual reconstruction” (Nelson & Sassi, 2005, p. 213) in order to construct new knowledge about the teaching and learning of mathematics that is supportive of the new intellectual culture required by the reform movement.

**Why conceptions?** The fundamental premise of this study is that principals’ *conceptions* of their leadership role in reforming mathematics teaching and learning impact *how* they choose to act. Therefore, the underlying theoretical construct of this study addresses the idea of principals’ conceptions of their role. Most of the research on conceptions and beliefs related to mathematics education has focused on teachers, and those who write about principals’ conceptions - their beliefs, ideas and knowledge - use the language of teacher research as a framework (see Nelson & Sassi, 2005; Prestine & Nelson, 2003; Stein & Nelson, 2003). In his review of the literature on mathematics teachers’ beliefs, Philipp (2007) suggests that beliefs “might be thought of as lenses through which one looks when interpreting the world” (p. 258). According to Thompson, who wrote extensively on teachers’ beliefs and conceptions about mathematics, teaching and learning, conceptions are a “mental structure encompassing beliefs, meanings, concepts, propositions, rules, mental images, preferences, and the like” (p. 130). McLeod (1992) adds that beliefs develop gradually and that socio-cultural factors tend to play a key role in their development, including the educator’s affect or disposition toward mathematics.

Thompson (1992) suggests that beliefs are flexible, influenced by new experiences and information, which means that educators can change their conceptions of mathematics teaching and learning through experiences with professional development and classroom practice with new pedagogy. Grant et al., (2003) and Nelson & Sassi (2005), in their research with principals and the teaching and learning of mathematics, found similar results. Through workshops and practice within their supervisory work, principal's ideas about the teaching and learning of mathematics and their supervisory practices began to change. Conceptions are dynamic.

This research seeks to explore each participant's individual cognition related to leadership and reform mathematics, paying special attention to how principals notice and interpret teaching events; and exploring how prior knowledge, beliefs, and experiences influence their construction of new understandings (Spillane et al., 2002). Thus, I am not looking at actions, per se, but at conceptions; how principals conceive of their roles based on their prior knowledge and practice related to mathematics teaching and learning, on their interpretations of reform policy, and on the context of their unique schools.

**Why mathematics?** Mathematics is increasingly seen as a “gatekeeper” to higher education and successful employment (Moses, 2001; Kitchen et al., 2007), and thus plays an important role in the lives of students entering an increasingly technological society. Mathematics education that lacks conceptual understanding as well as procedural competence inhibits opportunities and options for students (Heibert, 1999; Heibert & Carpenter, 1992; NCTM, 2000). Conversely, a strong command of mathematics “as a descriptive tool to make sense of and model reality can give students a sense of agency” (Turner & Varley, 2007, p. 6) and can help students to evaluate the mathematical reasoning

or reality behind political and social decision-making. The *Principles and Standards for School Mathematics* (NCTM, 2000) states that “a lack of mathematical competence keeps doors closed” to a productive future for our youth (p. 5). One principal participant noted that in the district in which this study takes place, a disproportionate number of ELL students were placed in remedial mathematics in middle school, which “tracked” them into other lower level classes due to scheduling constraints (Mr. Torres, 6/2/09). Thus many students in the study were among those in danger of being denied access to mathematical competence and greater educational opportunities.

Despite the existence of the *Standards*, and the concerted efforts by researchers, classroom teachers, administrators, and teacher-leaders, the teaching of mathematics continues, in many schools and classrooms, to be highly varied and often resistant to change and reform. Principals have a role to play in ensuring that mathematics expertise and leadership are developed to support the professional growth of mathematics teachers and to ensure equitable access for all students.

**Why Hispanics?** Mathematical power must be considered the right and the expectation for every student. As a research fellow in the Center for Mathematics Education for Latino/as (CEMELA), I am particularly interested in research that contributes to improving mathematics education for Hispanics. (The term Hispanic is used in this study interchangeably with Latino/a. Hispanic is the term used in the site where the study takes place, as well as in the demographic and accountability reporting). Educational statistics (NCELA, 2008), as well as qualitative accounts of schooling, “indicate that many institutional structures reflect a current political landscape that marginalizes students of color and students living in poverty” (Turner & Varley, 2007, p. 2). Research from the PEW

Hispanic Center (Fry & Gonzales, 2008) paints a bleak picture for Hispanic students, who test as less proficient than Whites and Asians in mathematics on the 4<sup>th</sup> grade NAEP, and fall further behind by middle and high school. Eighty-one percent of 8<sup>th</sup> grade Hispanics score below the basic level on the NAEP assessments; only nine percent reach proficiency.

Hispanic students who complete high school have skills in mathematics equivalent to the skills of White students in 8<sup>th</sup> grade (Haycock, 2004). In 2006, the dropout rate for Hispanics was twenty-two percent while for Whites it was only eleven percent (National Center for Education Statistics, 2008).

In the state where this dissertation study takes place, the NAEP data from the 2007 assessment continues to show an alarming gap between proficiency rates for Hispanics and White and Asian students (National Center for Educational Statistics, 2008 (Figure 1.1).

NAEP Data for State	Percent of students	% Proficient or above at Grade 4	% Proficient or above at Grade 8
<b>White</b>	30	48	39
<b>Hispanic</b>	56	17	11

**Figure 1.1 NAEP Proficiency Data in State Where Study Conducted.**

These statistics are disappointing in light of over twenty years of research indicating best practices for improving student learning in mathematics. This data suggests that effective strategies have not been widely implemented (Kitchen et al., 2007). The National Council of Supervisors of Mathematics (NCSM) *PRIME Leadership Framework* has clearly

identified that “it is the responsibility of mathematics education leaders to ensure underperforming student populations are identified and to . . . address gaps in student achievement and identified gaps in access to the curriculum” (NCSM, 2008, p. 10). This means principals must monitor the progress of traditionally underperforming populations (in the case of this study, Hispanic students), particularly those who are ELL. All students must have access to solid support for their learning, support that is responsive to their prior knowledge, intellectual strengths, and personal interests.

### **Purpose**

In 2003, Stein & Nelson employed a construct called leadership content knowledge (LCK) to help explain the complex nesting of cognitive understandings that leaders must have to successfully guide and supervise mathematics teaching and learning. They used the construct in their research to help in understanding how principals’ beliefs and knowledge about mathematics, teaching and learning affect their leadership practices. Leadership content knowledge (LCK) can “equip administrators to know strong instruction when they see it, to encourage it when they don’t, and to set the conditions for continuous academic learning among their professional staffs” (Stein & Nelson, 2003, p. 425). Their research and LCK provide a foundation for understanding the importance of principals’ beliefs about mathematics, teaching and learning in their roles as supervisors and leaders of inquiry-based mathematics. My study is intended to extend on that research, to be more inclusive of how these conceptions (beliefs, ideas, understandings, experiences, and knowledge) are affected by external messages having to do with policy, from outside the school domain and by the social context within. The study is set in predominantly low-income Hispanic schools in



order to highlight the importance of leadership that includes a focus on opportunity for all students to learn rigorous and relevant mathematics (NCTM, 2000, p. 8).

### **Background of Study**

The following episode from one principal's practice highlights the challenges of brokering the reforms at the "street level".

*On this October Tuesday morning, Ms. Rojas, the principal at Sands Elementary, sits at a conference table in her office with the Academic Coach and the Assistant Principal, discussing how to support a teacher who is really struggling with the new mathematics curriculum. It is clear from their conversation that the situation has become critical. The teacher was in tears in the teachers' lounge that morning, having declared, "I can't teach math with this program. I'm ready to quit!"*

*Principal Rojas: I looked at these curriculum materials during the week. I don't even understand a lot of the math. It seems pretty demanding. I'm pretty sure she just doesn't have the math skills for teaching this program. I think that's why she had the melt down.*

*Academic Coach: Well, I am getting some training at the coach's meetings, but I haven't taught the program. I don't really feel I know it well enough to support her yet with the teaching. Maybe I could do a basic math workshop for teachers on Friday mornings before school. That would help them with some of the math concepts they don't feel confident with. I think I could do that.*

*Assistant Principal: Would she come on her own time?*

*Principal Rojas: You'd think if she doesn't know what to do in math, she'd want to attend. But she also needs someone to model lessons for her in the classroom. The district promised us support, but they aren't giving it. Maybe we can ask the Learn Network to provide some support. We have that grant for one more year.*

*Assistant Principal: Does LEARN know how to help teachers who have English language learners? She has a lot of ELL kids, and the majority of them end up going into the remedial math program in Middle School!*

*Principal: I don't know. We hired her because she is bilingually certified, but her kids have the lowest test scores. I think there is a lot to work on. I'm just not sure where to start.*

In this episode from a principal's practice, four challenges stand out that will take significant leadership effort to overcome. These challenges are: 1) leading mathematics reforms that call for a significant shift in teaching pedagogy and new learning for principals; 2) leading to ensure opportunities for all students to learn rigorous and relevant mathematics; 3) brokering policy and accountability expectations; and 4) making sense of the reforms in the social context of the school.

**Challenge 1: Leading the reforms – a paradigm shift.** The first challenge for leading the reforms lies in intent of the reform mathematics movement itself. *Reform* argues for a problem-solving approach to mathematics by which all students “should be encouraged and enabled to explore, reason logically, draw inferences, and employ a variety of mathematical methods to become mathematically literate” (NCTM, 1989, p. 6). The mathematics reform movement emphasized pedagogy that seeks to interpret the learner's mathematical ideas and misconceptions (Ball & Cohen, 1999). These ideas have meant major shifts in classroom instruction that challenge traditional paradigms of the teaching and learning of mathematics. Researchers have learned that transforming teacher practices is a complex process (Ball & Bass, 2001; Ellis & Berry, 2005). For many teachers, this shift from what has been called an “instrumentalist” paradigm to a reform problem-solving paradigm has meant a dramatic shift in pedagogy requiring strategic, comprehensive professional development, often addressing fundamental changes in teachers' beliefs and understandings about mathematics, teaching and learning (Ellis & Berry, 2005; Franke et al., 1998; Lampert, 2001; Ma, 1999; Sfard, 2003).

An *instrumentalist* paradigm views mathematics as a system of rules and procedures that lead to efficient problem solving. This view includes the idea that mathematics is a vast

collection of infallible concepts and skills (Romberg, 1992, Skemp, 1976). Thus, classroom instruction is organized around the transfer of information from knowledgeable teacher to uninformed students. Elementary instruction in the instrumentalist view emphasizes the mastery of number facts and algorithms that are the building blocks and tools for more difficult conceptual tasks experienced later (Cobb, Wood, & Yackel, 1990). The problem-solving view of reform mathematics, on the other hand, has a focus on how students come to form meaningful understandings of and connections between mathematical concepts, articulate insights, explain and justify mathematical arguments, and apply knowledge to new situations (Cobb, Wood, & Yackel, 1990; Steffe & Cobb, 1988.)

Principals have the unique role of supervision that can both provide support for teachers to construct new ideas about mathematics, teaching and learning, as well as provide the “press” to hold them accountable for implementation in a manner consistent with program philosophy (Cobb & Smith, 2008; Cohen & Ball, 2007; Remillard, 2005). But principals must understand what they are looking for in the mathematics classroom. Transforming teaching pedagogy to comply with these research-based practices suggests that leadership content knowledge (LCK) must include an understanding of those practices, as well as the ability to monitor and promote what NCTM (2000) has identified as the six reform Principles of mathematics: the Equity Principle, advocating high expectations and strong support for all students; the Curriculum Principle, calling for a design that is coherent, focused on important mathematics and well articulated across the grades; the Teaching Principle, requiring teachers to understand what students know and need to learn, and then challenging and supporting them; the Learning Principle, promoting learning with understanding, actively building new knowledge from experience and prior knowledge; the

Assessment Principle, promoting assessments that support the learning of important mathematics by informing and guiding teachers as they make instructional decisions; and the Technology Principle, recognizing that technological tools can support students in every area of mathematics from kindergarten on.

The *Principles and Standards for School Mathematics* (PSSM, 2000) describes the strong role leaders can play in implementing reform:

[The Principles] can influence the development of curriculum frameworks, the selection of curriculum materials, the planning of instructional units or lessons, the design of assessments, the assignment of teachers and students to classes, instructional decisions in the classroom, and the establishment of supportive professional development programs for teachers. (p. 12)

Developing the leadership content knowledge to effectively manage adherence to these principles is no small task. Principals are faced with having to provide instructional leadership as both they and their teachers explore and develop new ideas about the teaching and learning of mathematics (Hiebert & Carpenter, 1992; Nelson, 1998). Principals participate in this work with their own specific beliefs about mathematics teaching and learning and their own ideas about working with adult learners.

In addition to beliefs about how to navigate change, principals' specific understandings of mathematics learning and teaching substantially affect the nature of the instructional leadership they exercise (Burch & Spillane, 2003; Nelson, 1999; Nelson & Sassi, 2005). Their ideas about mathematics teaching and learning impact what they value and how they choose to act with regard to professional development, supervision, staffing, and setting expectations for teachers and students (Hallinger & Heck, 1996, Nelson, 1998;

Reys, Chavez & Reys, 2003). How principals support teachers, supervise for fidelity of implementation, consider language and cultural issues related to mathematics, and work with parents and community are critical to a strong mathematics program (Kitchen et al., 2007; Nelson, 1998; Reys, Robinson, Sconiers, & Mark, 1999). Yet studies show that principals have little knowledge of the changes implicated by reform in mathematics teaching and learning (Burch & Spillane, 2003; Price, Ball, & Luks, 1995) and often rely on their teachers or outside “experts” to take responsibility for mathematics reform efforts because they perceive their own knowledge of mathematics education to be limited (Larson & Howley, 2006).

**Challenge 2: Ensuring opportunities for all students to learn rigorous and relevant mathematics.** The NCTM Equity Principle argues,

“All students, regardless of their personal characteristics, backgrounds, or physical challenges, must have opportunities to study and support to learn mathematics” (NCTM, 2000, p. 12). It is intended to ensure that policies, resources and opportunities are organized so students are “enabled to utilize their cognitive and social abilities in order to become upwardly mobile” (Quiroz & Secada, 2003, p. 89). Reforms must address access, supporting teachers to build mathematics classrooms that are intellectual and social communities “where differences are respected as assets” (Anderson, 2003, p. 11). At the organizational level, principals are in a position to provide professional development for teacher communities aimed at defining the issues “in terms of their particular experiences and the problems of their particular student populations” (Quiroz & Secada, 2003, p. 88). To turn the conversation toward meeting the needs of diverse learners, principals must understand and promote the recommendations found in the Professional Standards for Teaching Mathematics

(NCTM 1991), which call for a mathematics pedagogy that builds on the understanding of how students' linguistic, ethnic, racial, gender and socioeconomic backgrounds influence their learning; the role of mathematics in culture; the contribution of various cultures to the advancement of mathematics; the relationship of school mathematics to other subjects; and the realistic application of mathematics to authentic contexts (Secada, 1995; Tate, 2005). Reeves (2006) points out a number of studies that show poverty and ethnicity have no relation to achievement growth. What does matter is teachers working in high inquiry teams. Changing teachers' practices will not be easy. Research findings suggest that teachers' tendency to blame the students and their families for poor performance in mathematics "represents a unique challenge for instructional leadership attempting to engineer school mathematics improvement" (Tate, 2005, p. 22). These findings challenge the role of the principal, for principals don't have control over teachers' beliefs. Yet they can help shift these beliefs through professional learning opportunities.

**Challenge 3: Brokering policy and accountability expectations.** In addition to learning what leaders believe about the reforms themselves, this study also considers how they make sense of external policies or "representations" (Spillane, Reiser & Reimer, 2002). To understand policy and accountability directives requires the individual to interpret those representations through their existing cognitive structures. This study explores how the participants make sense of policy and attempts to connect that understanding with practice. Three areas of policy related to implementing mathematics reforms are considered: state and district accountability mandates; curriculum adoption and expectations for fidelity; and district mandated supervision policies.

Under the federal *No Child Left Behind* legislation and state accountability rules,

principals are under unprecedented pressure to prioritize the improvement of teaching and learning of mathematics (NCLB, 2002). Principals and teachers face the “twin challenges of raising the bar overall and closing the achievement gap” (Center for American Progress, 2008, p. 1). Educators are under pressure to drive sustained improvements in teaching and learning in every classroom, at the risk of their jobs (Leithwood, Louis, Anderson & Wahlstrom, 2004). How principals help teachers to make sense of data to inform their teaching, and integrate high-stakes summative data with classroom formative assessments is a “street-level” decision-making process that can have implications for how the reforms are implemented. If teachers feel compelled to prepare students for the standardized assessments, it can “create incongruence” and “change the substance of [mathematics] conversations” (Coburn & Russell, 2008, p. 225) about what is taught and how. Unless educators in general understand the information on the complexities of the purposes for the assessments, the outcomes of the assessments, and the implications of the data, “there is bound to be misinterpretation of the data” (Gottlieb, 2006, p. 8) and consequences for student learning, including inappropriate placement decisions based on assessments where mathematics proficiency may have been masked by language factors (Celedón-Pattichis, 2004). In addition, short-cycle assessments are only a partial representation of student learning.

A second policy expectation in many districts, including the one in this study, is that a single standards-based mathematics curriculum be used. Districts adopt a single curriculum in hopes of standardizing teaching and learning and of economizing resources, including professional development and materials. In spite of these intentions, research shows a tremendous variation in the level of implementation within and between schools, which suggests principals are interpreting and enacting curriculum expectations very differently

(Briars & Resnick, 2000). Curriculum adoption without systemic attention to the support and guidance that aligns teaching practices, often called enactment, with curriculum implementation as intended has not been successful (Briars & Resnick, 2000; Cobb & Smith, 2008).

A third policy representation that requires interpretation and enactment by the principal is district policy related to the supervision of teachers. This often entails the use of forms to guide classroom observations and teacher evaluations. Classroom walk-through checklists and teacher observations forms are standardized and required. But, “policy messages are not inert, static ideas that are transmitted unaltered into local actors’ minds” (Spillane et al., 2002, p. 392). They are framed, interpreted and conceptualized according to each principal’s sense-making. A small group of researchers have done extensive studies of how principals’ supervisory practices are influenced by their beliefs and understandings about mathematics, teaching and learning (Nelson, 1998, 1999; Nelson & Sassi, 2005; Stein & Nelson, 2003). Their findings indicate that principals with high leadership content knowledge know what to look for in reform teaching and learning, and thus can use supervisory tool and practices to promote changes in teacher behavior.

**Challenge 4: Navigating the social context.** Leadership content knowledge and policy implementation do not happen in a void. Leadership practices and teaching practices are situated in a “complex web of organizational structures, social networks, and traditions” (Spillane et al., 2002, p. 404). What works in one school may not work in another. Adding the dimension of social context suggests another way that differences in knowledge affect sense-making and role conception. This investigation explores each principal’s social context in terms of two foci suggested by Spillane (2005): institutional structures (normative



ideas that organize how people interact with one another – roles, positions, expectations) and relational structures (the interconnections and interdependencies among people).

In describing the institutional context, the first characteristic to document is the demographic make-up of the school. This aspect is easiest to document, yet it can deeply challenge the reform principle of equity and access. Racial and socio-economic make-up of the student community “can shape human agency” (Spillane, et al. 2003, p. 405). When there is a school culture that believes in a “framework of inequities” (Khisty, 1995), there is a deep rooted assumption that the problem resides in factors related to cultural deficits, pinpointing what students do not know mathematically or linguistically or culturally, rather than building on what knowledge and understandings they do bring. McKenzie and Scheurich (2004) describe school cultures that create equity traps as a result of “dysconsciousness that prevents us from seeing and believing in the possibility that all students of color can achieve and that we have the ability and the will to make this happen” (p. 603). As Campbell and Silver commented in their 2000 report to NCTM,

Implementation of reform faces greater challenges in districts composed of schools of poverty than do other school systems, including how to effectively teach a core mathematics curriculum to students of limited English Proficiency. However, instructional approaches that emphasize conceptual understanding of mathematical ideas and procedures within a broader range of content offer the most promise for effective mathematics instruction in schools of poverty. Effective teachers organize their instruction to build on students’ prior knowledge as they promote and maintain solid classroom interactions with their students. Classroom discourse can then be a

mechanism to promote mathematical analysis, reflection, verification, and justification. (Campbell & Silver, 2000, p. 63)

It is a delicate path to walk to guide a dysconscious school culture toward equity. It means teachers and leaders need to understand and confront their own biases.

Other components of institutional context are the cultural phenomena that guide social action. These include infrastructure, including scheduled time for teacher collaboration and planning, professional development, sufficient instructional blocks for mathematics teaching, materials, and professional development.

Relational structures, particularly those related to mathematics reform and the implementation of a new curriculum, are particularly powerful in influencing what Spillane et al. (2002) call “enactment zones”, where supervisory press and district policies “meet the world of practice” (p. 407). Relational structures can promote either collaborative or isolationist practices. A culture of collaboration, where teachers’ practice extends beyond their individual classrooms to include frequent and ongoing deliberations with other teachers provides an environment for growth and change (Kazemi & Franke, 2003; Spillane et al., 2002). Without a collaborative learning culture, teachers’ “enactment zones are mostly private and individualistic and afford them few opportunities to grapple with the meaning of policy makers’ proposals for revising practice” (Spillane et al., 2002, p. 406).

### **Research Sub-questions**

The central premise of this research is that principals construct their role in leading the reforms through a dynamic interaction between their leadership content knowledge, policy interpretations, and school social context. Therefore, four sub-questions are added to the research:

- What conceptions (beliefs, ideas, knowledge, experiences, understandings) related to mathematics and the principles of mathematics do principals bring to their leadership role?
- How do principals make sense of the district policies related to the reforms (curriculum, equity, accountability)?
- How does the social context of the school community influence their ideas about leading mathematics reforms?
- How do LCK, policy mediation and social context result in principals' conceptions of leading adult learners?

### **Theoretical Stance and Conceptual Frame**

This study of mathematics leadership is grounded in the larger framework of constructivism as a theory of learning for all learners, young and old. Reform mathematics is based on a constructivist theory of learning that involves the engagement of the learner *doing* mathematics. Constructivism requires an active educational process for understanding mathematical ideas through social interplay and “active engagement in tasks and experiences designed to deepen and connect their knowledge” (NCTM, 2000, p. 21). This study takes a constructivist stance in considering how principals construct their leadership roles through interaction with mathematics, teaching and learning, and their interaction with policy and school social context.

The role of the principal as leader is complex. Mathematics reforms are complex. In order to investigate these two ideas simultaneously, a sturdy conceptual framework is needed to guide the research and to organize the findings. I employed two theoretical constructs in the research design and in analyzing the data. The first is a construct proposed by Stein and

Nelson (2003), called leadership content knowledge, or LCK. Much like Shulman's (1987) pedagogical content knowledge, LCK refers to administrators' "knowledge of the subject matter of instruction, beliefs about how it is learned and how it is effectively taught" (Reed, Goldsmith & Nelson, 2006, p. 1). Since the idea of LCK was particularly constructed to understand principals' actions as observers and supervisors of mathematics teaching and learning, it does not fully suffice to "get at" the interconnections between school context, classroom practices, and district policy, where principals make sense of the mathematics they must supervise in the context of their school and the policies they are expected to mediate.

To understand how principals' conceptions of leading the reforms come into play with policy and social context, I employ a second theory, developed by Spillane et al. (2002) that combines cognition and sense-making. This cognitive framework helps to integrate *what* beliefs and ideas principals have cognitively constructed about mathematics teaching and learning with *how* they mediate policy messages within their unique school contexts. Thus, the research is designed to discover not how well the principals lead or how their conceptions lead to actions and student outcomes. Rather, I wish to know simply how. *How* do they conceive of the challenges of leading mathematics reform.

### **Research Design**

In order to address the complex and abstract nature of the research questions, the study is positioned within a qualitative approach (Denzin & Lincoln, 2000). To arrive at well-founded insights, I employ a qualitative case study analysis of three elementary school principals at predominantly Hispanic-serving schools. While each case was "a concentrated inquiry into a single case" (Stake, 1995, p. 87) the overall study took the form of a cross-case study (Bogden & Biklen, 2007; Stake, 1995). This purposively small sample enabled me to

capture the voice of experience while maximizing the possibility of illuminating the thinking of principals involved in mathematics reform efforts. Through a series of semi-structured taped interviews, classroom observations in which I accompany the principal, focus group interviews with all three principals together, conversations with district personnel, and researcher memos, I sought to learn about principals' conceptions of their leadership roles in mathematics teaching and learning at their schools.

Principal interviews were designed to elicit their ideas and beliefs about the pedagogy of mathematics, including experiences that contribute to their own understanding of mathematics, teaching and learning; ways to support their teaching staffs with implementation of the reforms; strategies for brokering accountability expectations and mandates from the district and state for improving mathematics proficiency levels of *all* students; and ways to improve opportunities for Hispanic students to succeed in mathematics. By accompanying the principals on classroom observations of mathematics lessons, I was able to gather descriptions of leadership practices and elicit their ideas about what they observed and how they supervised.

The interview and observation data, along with researcher memos, were analyzed using several methods, including detailed transcriptions of interviews, coding and categorizing interview text, and thematic analysis of interview data (Bogdan & Biklen, 2007). A representation of each principal's leadership content knowledge was then constructed, as well as an analysis of how their beliefs and understandings mediated policy and social context related to the reforms.

Case study methodology offered some important benefits. First, it allowed participants' conceptions to be considered and interpreted in the context of their own

bounded systems, minimizing the distortion of meaning. Second, the contextualizing of principals' stories within their individual schools, and within the larger district helped to illuminate their sense-making about district policies related to the mathematics reform initiative. In Chapter Seven, based on an analysis and synthesis of the findings in relation to the research questions for each participant, I look across cases for some commonalities and differences in how principals conceive of their roles. In this chapter, a clearer picture emerges of which leadership challenges and beliefs are shared and which are individualized.

The research design and methodology were selected in hopes of providing the best “environment” for explicating the participants' conceptions of their leadership for mathematics reform. However, I acknowledge that certain limitations should be taken into account in considering the study's analysis. First, the study involved only three cases. Therefore, it is not clear that the findings are applicable to principals or schools other than those in the study. *However*, case studies, like experiments, are generalizable to theoretical propositions and not to populations or universes (Yin, 1994). To claim this as a case study is to assert that these principals are members of a group of similar cases of which they are in some sense representative.

Second, while the analysis draws on a number of sources of data, significant reliance was placed on interview data – what the participants described about their leadership ideas and identified as important to them. Thus the reliability of the data depended on the respondents' willingness to give accurate and complete answers. The research design that includes multiple interviews triangulated with classroom observation data, focus interviews, and researcher memos, will help provide greater reliability.

Finally, my own involvement as a researcher carries the mark of my own experience and voice, my conceptual understanding of leadership and mathematics reform. Therefore, it is particularly important to represent as much of the participants' voices as possible in presenting the findings.

### **Organization of Thesis**

The presentation of this study is divided into seven chapters. The following chapter-by-chapter explanation is intended to outline the logical sequence of the study as it unfolded. The essential features of each chapter are as follows.

Chapter One serves as an overview and a justification for the study. The purpose and significance are clarified against a brief background and context for leadership and mathematics reform. A summary of the theoretical frame, the research design and methodology, and the researcher lens are considered.

Chapter Two provides a detailed explanation of the theoretical orientation and conceptual frames grounding the research. I detail a social constructivist orientation toward knowledge, learning and teaching; and then integrate two theoretical constructs to form the conceptual framework. This important chapter sets the structure for the design of the study and the analysis of the findings.

Chapter Three reviews the literature that has informed this study by focusing on three distinctive sections of the literature related to the research questions. First, I position the research through the lens of a particular interpretation of the notion of role conceptions. Then I discuss the prescriptive and empirical research on school leadership to explain current thinking on best practices for instructional leadership in schools. The rest of the chapter reviews literature specific to the challenges highlighted in Chapter One: the challenges of

leading the significant change demanded by mathematics reform; leading to ensure opportunities for all students to learn rigorous and relevant mathematics; brokering policy and accountability expectations; and building institutional and relational structures to support the reforms.

Chapter Four contains the rationale, design, and methods employed in carrying out the study. Consideration is given first to the methodological choice. An explanation of the data collection and analysis follows. Finally, issues with validity and reliability, bias, and the study's significance are discussed.

Chapter Five begins the analysis of the findings with the district's story. The choices and decisions made at the district level will be shown to have significant impact on principals' conceptions of their role in leading the reforms. This chapter sets the context for the policy and accountability sense-making with which principals grapple. It sets the historical and structural context for how the mathematics reform initiatives were rolled out to schools, what policy representations were delivered, and what guidance and support was provided. .

Chapter Six tells the individual story of each case, addressing each of the research sub-questions for each principal. Personal and professional histories related to mathematics, teaching and learning are analyzed, followed by a discussion of each principal's LCK and cognitive structures related to mathematics. Each story concludes with a synthesis of that principal's conceptions of her role in leading the reforms at her school.

Chapter Seven brings all of the stories together to present common findings across cases. This chapter is intended to highlight the challenges and successes of leading mathematics reform according to the conceptions of each of the principals. The theoretical



frame is employed to organize the findings, findings that informed the final synthesis of a new construct that blended LCK and sense-making.

In Chapter Eight, the final chapter, I develop a comprehensive response to the overarching research question: “How do principals conceive of their leadership roles in the implementation of a district-wide reform mathematics curriculum in predominantly Hispanic-serving schools?” New insights are presented. Conclusions are drawn in relation to the research question and implications of the conclusions are discussed along with suggestions for further research.

It is my hope that this research will enhance the understanding of how principals’ conceptions of their leadership role in mathematics reform are dynamic and varied. It may help to explain why educators continue to be challenged by implementing reforms at scale, especially those serving low-income Hispanic families. The research may also offer insight into the work that needs to be done to help principals align their conceptions of leadership with best practice research.

## **Chapter 2: Theoretical Orientation and Conceptual Framework**

This study is situated in and builds on three bodies of research that provide a framework for interpreting the findings: social constructivism, leadership content knowledge and sense-making. I begin this section by organizing the main assumptions underlying the study in the broad theoretical orientation of social constructivism. These assumptions present an orientation toward knowledge, learning, and teaching that are aligned with the Teaching and Learning Principles of the *Principles and Standards for School Mathematics* [PSSM] (NCTM, 2000) and the mathematics reforms this study addresses. Within the broad orientation of social constructivism, I then have chosen two constructs that conceptually frame the study: leadership content knowledge and sense-making. It is the integration of these two constructs that helps to situate the role of principal leadership in mathematics reform.

### **Social Constructivism**

As a learning theory, social constructivism suggests that individuals internally construct their own knowledge via the effects of social mediation, and that language plays an important part in this overall process (Cobb & Yackel, 1996; Fosnot, 1996). Individuals create their own understandings, but are assisted in this endeavor by language and mediation within a social environment. This perspective has provided the theoretical underpinning of numerous studies on student learning in mathematics (Cobb et al., 1992; Lampert, 2001; Yackel & Cobb, 1996). In addition, since teachers are learners, constantly constructing new meanings, social constructivist theory has framed much of the research on teacher learning (Ball, Hill & Bass, 2005; Lampert, 2001; Ma, 1999; Schifter, 1999).

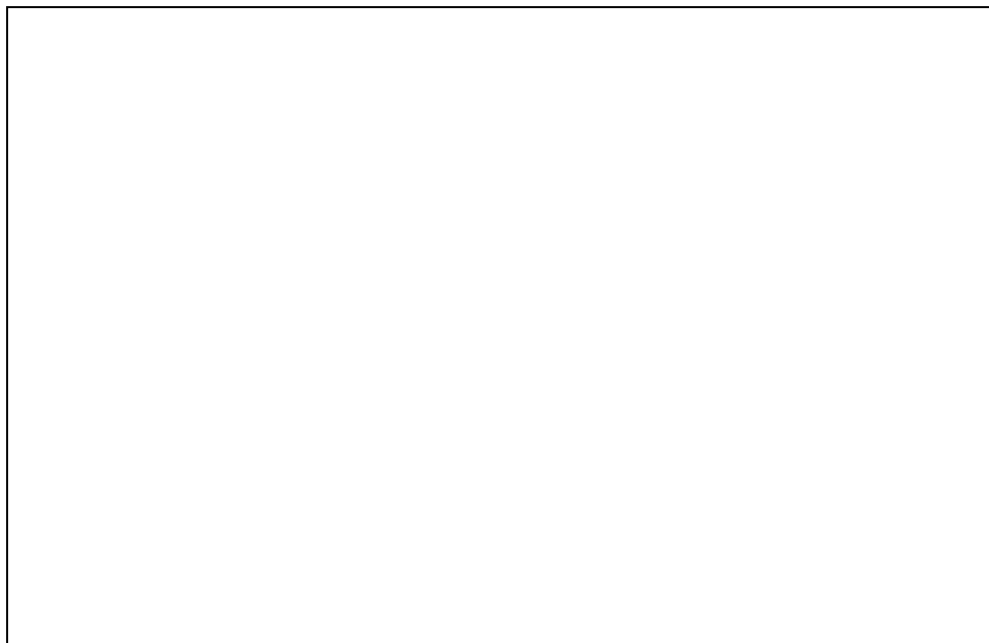
Another social constructivist who has influenced the research on teachers' roles in reform mathematics is Schulman (1987). He proposed that there are "three categories of content knowledge: subject matter content knowledge, pedagogical knowledge and the curricular knowledge" (p. 9). He called this composite "pedagogical content knowledge" or PCK. Research on developing PCK for teaching reform mathematics (Ball, 2000; Ball, Hill & Bass, 2005; Stigler & Hiebert, 1999) has realized that teachers, like the students they teach, need opportunities to construct an understanding of the mathematics, the teaching, and the learning. My study builds on that work by assuming that principals, too, are learners, and must construct meaning from subject knowledge, pedagogical knowledge, curricular knowledge and knowledge of adult learning.

### **Leadership Content Knowledge**

Within the socio-constructivist orientation toward teaching and learning, a particular conceptual construct has been articulated that frames my inquiry, helping to examine principals' conceptions related to the subject of mathematics, the teaching and learning of mathematics, and the supervision and support of teachers as they implement the reforms. A group of researchers (Nelson & Sassi, 2005; Reed, Goldsmith & Nelson, 2006; Stein & Nelson, 2003) seeking a greater understanding of effective leadership practices in elementary mathematics has developed a theoretical construct adapted from Shulman's construct, called *leadership content knowledge (LCK)*. This theoretical construct provides substantive ideas about "how and why subject matter knowledge matters in educational leadership" (Stein & Nelson, 2003, p. 424) and includes elements from both learning and accountability views of leadership. The accountability elements are important because positional administrators bring additional accountability by virtue of their leverage as evaluators. The learning aspect of the

LCK construct is important, as it accommodates the research findings that teachers must believe serious engagement in their own learning is an important piece of what it means to be a professional (Cobb & Thomas, 2008; Nelson & Sassi, 2005; Stein & Nelson, 2003).

There are actually four kinds of knowledge involved in the LCK construct, organized hierarchically. The nested schema is helpful in conveying both the complexity of LCK and in providing a framework for discussing policy representations, as described in the third conceptual framework below. Figure 2.1 is an adaptation of a diagram presented by Stein & Nelson (2003) that helps delineate the kinds of leadership content knowledge.



**Figure 2.1 Leadership Content Knowledge (Stein & Nelson, 2003).**

At the most basic level, principals must understand something of the subject matter they are supervising. An empirical study by Stein and Nelson (2003), looked more closely at what administrators believe or understand about their leadership role in mathematics reform, not just at what they do. They profess that administrators who claim to be instructional

leaders “must have some degree of understanding of the various subject areas under their purview” (p. 424). They argue that subject matter knowledge is related to how to lead - standing at the intersection of subject matter knowledge and the practices that define leadership. Knowledge of general pedagogy is not enough. Combining pedagogical knowledge with some depth of content knowledge allows a leader to evaluate student learning – what kinds of questions the students and the teacher are asking, what difficulties students may be having with mathematical concepts and how the teacher is facilitating understanding. Interestingly, they conclude from their research that “at minimum, school administrators should have real depth of knowledge and expertise in one school subject” (p. 443). This could be a subject they loved teaching, not necessarily mathematics, but they should know the subject (content) and how it is taught (pedagogy), as well as how children’s knowledge of that subject develops, what ideas are typically difficult, and what good instruction in that subject looks like. This will truly ensure that administrators have depth of understanding in a subject to “support organizational conditions that will allow adult professionals and students to learn” (p. 443). In addition, this research concludes that principals should dig down into a slice of knowledge in other subjects to understand the nature of learning in those subjects as well.

Without knowledge that connects subject matter, learning, and teaching to acts of leadership, leadership floats disconnected from the very processes it is designed to govern. Just as the construct of *pedagogical* content knowledge has marked out new and very generative research questions and sites for research, so the construct of *leadership* content knowledge may open up new questions about what it means to provide instructional leadership in schools. (Stein & Nelson, 2003, p. 446)

In the nested construct of LCK, the inner-most level is mathematics subject knowledge. LCK researchers suggest that elementary and middle school principals vary in their knowledge of mathematics, on a conceptual continuum and on a procedural continuum (Nelson, Bensen & Reed, 2004). This knowledge impacts how they enact their roles as supervisors (Nelson & Sassi, 2005), shaping how they set the direction for the reforms and support teachers in learning and implementing the reforms. Related to knowledge of the subject of mathematics, principals' conceptions are influenced by their philosophies about mathematics. Ernest (1991) offers two epistemological categories of mathematical philosophies: absolutism and fallibilism. The former, which Ernest claims to be "the dominant epistemological perspective of mathematics" (p. 3) holds that mathematics contains infallible unquestionable, and unchangeable truths. As such, mathematics might be taught as a series of rules to apply in order to arrive at a required answer. Fallibilism, as the name implies, sees mathematical truth as fallible, where "mathematical concepts and proofs can never be regarded as beyond revision and correction . . . a dialogue between people exploring mathematical problems . . ." (Neyland, 1995, p. 143). *Reform*, according to Ellis and Berry (2005), "raises questions about the core beliefs of mathematics education . . . how it is taught, how it is learned, and ultimately, what constitutes success in learning it" (p. 8).

At the next level of LCK, in the interactions between teachers and students around mathematics, principals need an understanding of how children learn mathematics and of research-based pedagogy to help students develop deep conceptual understanding. As principals observe in classrooms, they bring their own

beliefs and ideas about teaching and learning to their supervisory practice. At this level, LCK refers to understanding how teachers interact with learners about mathematics and “socialize students into the world of literate knowers” (Stein & Nelson, 2003, p. 426) of mathematics. But developing an eye for effective reform teaching and learning requires a shift from a focus on teacher behaviors, as reflected in many walk-through checklists that include such “look fors” as the use of manipulatives, small group work, and student engagement (see McEwan, 2000), to a focus on “how well teachers’ decisions support the development of mathematical ideas” (Nelson, Sassi, & Driscoll, 2000). In a study of twenty rural high-school principals, Howley and colleagues (2007) reported that most of the principals were able to articulate the importance of problem-solving situations and of teachers understanding how students arrived at an answer. Yet principals’ understanding of the reforms tended to be superficial, focusing on having teachers “try to explain the ‘why’ whenever possible” (p. 5) rather than on student understanding.

Although no research has been done related to LCK and language and culture in the mathematics classroom, the teaching and learning of mathematics in the problem-solving approach includes making rigorous mathematics accessible to all students. Therefore, the second level, the instructional level, is where principals must also understand best practices in meeting the needs of culturally and linguistically diverse students in the content area of mathematics.

The substance of the work in the third layer “is more complex” (Stein & Nelson, 2003, p. 8). It encompasses the two inner layers, and additionally has to do with assisting teachers to improve their performance in the classroom and to improve mathematics teaching

at scale. It requires knowing something about teachers as learners and about effective professional development and collaborative communities of practice (Cohen & Hill, 2000; Nelson & Sassi, 2005; Stein & Nelson, 2003). The research discussed above on the challenges with a problem-solving or inquiry approach suggests that principals need to know something of the history of pedagogy in the subject and the challenges for teachers in developing new beliefs and new instructional practices. It also includes having the strength of character to hold teachers accountable for their professional learning (Prestine & Nelson, 2003). The “teacher as learner” notion implicated at this third level is supported by current research that redefines instructional leadership as “learning leadership” (Eaker, Dufour & Dufour, 2007) and includes a vision for building professional learning communities around instructional improvement.

The fourth layer concerns broader district-level issues that relate to improving mathematics teaching at scale and deals with a variety of adult learners: teachers, principals, curriculum coordinators, etc. One important aspect at the district level is policy representation. What messages are given to schools about curriculum, the need to reform practices in mathematics teaching and learning, accountability measures, and supervisory roles? What policy messages, guidance and supports are given to schools as they are challenged with implementing reforms? It is at this level that the LCK construct considers principals as learners, for principals, too, bring pre-conceptions to the learning enterprise (Stein & Nelson, 2003). In a study of 40 school administrators, Nelson (1998, 1999) found that without professional development to influence principals’ thinking about mathematics education reform, principals thought of instruction primarily as the transmission of information. They considered supervision primarily as a top-down effort to change teachers’



behaviors. After a project designed to promote ideas about problem-solving approaches to mathematics teaching and learning, principals were more open to the idea that teachers construct knowledge that informs their practice, including knowledge about mathematics, about how children learn, and about how instructional practices work. This understanding led to a change in their supervisory practices toward more collaborative conversations with teachers about student thinking.

The LCK nested construct is based on a belief that there are learners at all levels of the system: students, teachers, principals, and even district staff. The learning of complex knowledge and skills at every level is supported by interaction between individuals with varying levels of expertise working toward the accomplishment of common goals (Lave & Wenger, 1991; Stein & Nelson, 2003). At each level, the educators are working and learning together in communities of practice to some degree, and a constructivist orientation assumes that new ideas are assimilated and become useful only through active coordination with existing knowledge and conceptions.

The LCK construct offers an exciting new framework for exploring principals' ideas about their roles in implementing mathematics reform. An exploration of how the LCK construct can affect leadership practice is being done through research that involves a course in which principals explore fundamental ideas about mathematics, learning, and teaching on which Standards-based mathematics education is based. Principals who receive training in standards-based mathematics education have "qualitatively different orientations toward mathematics learning and teaching" (Nelson et al., 2004, p. 44). Further work by Nelson & Sassi (2005) suggests that these orientations result in qualitatively different supervisory behaviors that impact teaching practices. What these studies do not seem to "get at" is the

sense-making that goes on between the layers of LCK as principals mediate both policy representations and the social context of schools. How do principals interpret all external expectations and demands through their own conceptual frameworks and thus conceive of a role in supporting and guiding the implementation of the reforms within their unique school environments?

In the LCK nested construct, the role of the principal is enacted in the third layer. Nelson & Sassi (2005) articulate this role as “interpreter, mediator, filter, arbiter of instructional quality” (p. 54). Principals’ own content knowledge is where their conceptions are rooted, yet responses and stimulus from the actors in the other domains influence those conceptions and ideas about enactment. While the word “role” is actually a noun, meaning “part played” (Merriam-Webster, 2009), it implies action, as in “role played” or “function performed” (ibid). I am interested in the sense-making that precludes action – the skills, values and assumptions that principals employ in conceiving of that role.

### **Sense-Making**

LCK is a very dynamic construct, and as such, there are implications for what influences a leader’s conception of her/his role in furthering the reforms. Another theoretical construct that helps to “get at” the beliefs, understandings, experiences, and interpretations that result in LCK is sense-making theory. It allows the researcher to look at the interconnections between the nested layers of LCK to learn more about how principals’ cognitive positions are influenced by policy representations on the one hand, and their school’s social context on the other. This theory also provides a framework to consider how principals’ sense-making is taking shape in their practice as it relates to mathematics reform.

An emerging line of research with *teachers*, known as the cognitive approach to policy implementation (Spillane, Reiser, & Reimer, 2002), has shown that teachers come to understand new policy ideas through the lens of their preexisting knowledge and practices. They often interpret, adapt, or transform policy messages in the course of their instructional practice (Coburn, 2005; Spillane et al. 2002). This line of inquiry has rarely focused on the role of school leadership, and *principal* sense-making has only recently been explored. In a case study of one school, Coldron & Spillane (2007) found that contextual factors including student and staff composition, as well as leaders' values and beliefs, influence instructional leadership practice. Sense-making theory, as outlined by Spillane, Reiser, and Reimer (2002), asserts that the nature and structure of formal networks and informal alliances among educators play a powerful role in shaping conceptions of subject, teaching, learning, and, by extrapolation, leading. This theory envisions a dynamic relationship between three constructs: the individual's conceptions, the social context (formal networks, informal alliances, history, demographics, etc.), and policy as represented through verbal and written media (regulations, directives, legislation, training, pamphlets, etc.).

Conceptions include prior knowledge, beliefs, experiences, and understandings (Thompson, 1992). In a discussion of teaching and learning, prior knowledge and practices can pose challenges because they may mean "a teacher or principal is unwilling to change to adapt to the reforms, or because their extant understandings may interfere with their ability to interpret or implement the reform in ways consistent with the intent" (Spillane et al., 2002, p. 394). Understanding requires accessing prior knowledge and applying it to "guide the noticing, framing and connecting of new ideas to what has already been encoded in memory" (p. 394). Related to the LCK construct, conceptual frameworks filter or serve as a lens for

what teachers and leaders attend to in reform messages. An implication of this concerns the difficulty of accommodating and assimilating new information. Piaget (1972) stressed the importance of encoding and accommodating stimuli into existing knowledge frames. While the brain seeks to accommodate by restructuring existing knowledge, it also seeks to conserve by making the unfamiliar familiar. This aspect of sense-making helps to explain the challenge of the paradigm shift in mathematics reform. Often new ideas are subject to “the danger of being seen as minor variations of what is already understood rather than as different in critically important ways” (Spillane et al., 2002). This study sought to better understand principals’ conceptual frameworks and how they might be understanding and interpreting the reform messages as either minor variations or as critically different.

The second aspect of sense-making theory concerns the influence of social context on conception. “Implementing agents encounter policy in a complex web of organizational structures, professional affiliations, social networks and traditions” (Spillane, et al., 2002, p. 404). Schools and school communities provide norms, rules, and boundaries that both constrain and enable action. Nested within these institutional environments are a number of arrangements that contribute to defining the ways people make sense of new ideas. Social interactions, both formal and informal can help individuals make sense of the reforms. In fact, Coburn (2001) observed that even within the same school, teachers make different meaning out of the policy messages about reading reforms. In a study of teachers’ responses to state and national mathematics standards, Spillane et al. (2002) found that “local contexts of enactment” (p. 407) mediate between policy levers and classroom practice. The success with which intended policy messages got translated into practice depended on the extent to which the contexts were social rather than individualistic, the extent to which they involved

rich discussions and reflections with other teachers, and the extent to which resources supported their communities of practice.

Hill (2001) studied a districts' standards document and the ways teachers assigned meaning to the terms within the document. She found that language is central in sense-making. The language of the documents was interpreted in a number of different ways in teaching practice. While language is the chief medium through which policy is represented and is a key tool that teachers use in thinking about and developing their practice, "language is an imprecise tool" (Spillane et al., 2002, p. 407). To overlay this aspect of sense-making theory and the idea of interpreted meaning with LCK suggests that the mediation of the language of policy with the language of reform teaching plays a significant role in how leaders conceive of their roles.

The third aspect of sense-making in this construct is policy related to the district mathematics reform initiative, as represented through verbal and written media. In reform mathematics, the policies inherent in the curriculum and recommended in the policy documents (NCTM Principles and Standards, 2000; NCSM PRIME, 2008) press for and guide significant changes in extant practice. The tractability of the current behavior (teaching pedagogy, curriculum beliefs, and beliefs about the subject of mathematics) that the policy seeks to address and the inherent features of the change, work together to influence how the reforms are implemented (Spillane et al., 2002). Researchers have found that the reforms are not asking for incremental change, and for many educators implementing reform requires the discrediting of existing schemas and frameworks. Educators will have to unlearn much of what they already know and believe about teaching and learning (Hill, 2001; Spillane & Zeuli, 1999). Education standards that press teachers to facilitate students' understanding of

mathematics through reasoning, conjecture, problem-solving, communication and justification demand changes that require teachers and administrators to explore their understandings of the nature of mathematics as a subject and what it means to teach mathematics to children, for it is through these understandings that they make sense of the policy representations.

This theoretical construct of sense-making suggests that it is actually a combination of what they know and believe about mathematics, teaching and learning, and the dynamic flow of information and ideas they get from district policy and school context that shape their conceptions. They receive information on best practices in mathematics reform through district presentations, informal networks, professional development, social networks, and observation. Meanwhile, principals are sense-making about what they observe in classrooms, hear from parents and students, and what teachers are saying about the reforms. They must also continuously amend their conceptual framework as they reflect on dissonant notions, interpret policy expectations, and navigate the social context of their schools.

The graphic in figure 2.2 details the combined constructs of LCK and sense-making theory. The new construct emerged while analyzing the data from the study. The development of the framework as a synthesis of LCK and sense-making occurred simultaneously with analysis of the data. Themes in the data suggested that principals do not conceive of the reforms only in terms of their own conceptions of mathematics, teaching and learning. Their ideas about leadership and mathematics reform are influenced by district policy and the school in which they practice. This model became the theoretical frame that helped in both synthesizing new themes and in organizing the research for presentation and discussion of the findings through an iterative process of looking at both constructs.



**Figure 2.2 A Dynamic Analytical Model of LCK and Sense-making.**

### Chapter 3: Literature Review

This review of the literature explores the research relevant to principal leadership and mathematics reform. I review prescriptive and empirical studies that help to highlight the complexity of the principal's role in improving student achievement in mathematics, particularly in schools with historically underserved populations. This review will demonstrate that, although there have been a number of studies that explored school leadership and a multitude that have investigated teachers mathematics reform, few studies have examined the role of the principal in mathematics reform, and of those, none have been situated in predominantly Hispanic-serving schools.

The literature review is structured to strengthen my assertion that research in mathematics reform needs to consider the important role of leadership and the beliefs and conceptions of the principal, in improving mathematics teaching and learning at scale. I have organized the research into three distinctive areas related to the research questions. I begin by positioning my research in a particular interpretation of the notion of role conceptions, a notion that fundamentally guides my study. I then discuss the extant literature, both prescriptive and empirical, on school leadership to explain current thinking on best practices for instructional leadership in schools. The third body of literature I discuss is research related to the challenges specific to leading mathematics instructional reform, including: (1) the mathematics reform movement itself, which presents significant challenges for leadership, and includes literature that makes recommendations for how instructional leaders can effectively lead that reform, (2) policy and accountability mandates related to improving student achievement in mathematics, along with the implications of NCLB; (3) research that



addresses equity in the teaching and learning of mathematics; and (4) research that considers the important role of social context in how implementers make sense of leading the reforms.

### **Conception of Role**

Central to my study is the question of principals' conceptions of their leadership role in mathematics reform. Thompson (1992), who extensively reviewed the literature on teachers' beliefs and conceptions, noted the importance for researchers to make explicit their own perspectives on the teaching, learning and nature of mathematics. For Thompson, it was important for researchers "to consider the discipline of mathematics and the relationship between what a teacher thinks about mathematics and how the teacher teaches" (Philipp, 2007, p. 258). In my research, I take a similar stance, in considering the discipline of mathematics, by looking at the relationship between what a principal thinks about mathematics teaching and learning and how the principal leads to improve student learning. This relationship between beliefs and actions is in line with a *constructivist* theory of mathematics teaching and learning, which holds that mathematics "is a social construction involving conjectures, proofs, and refutations, whose results are subject to . . . change and whose validity, therefore, must be judged in relation to a social and cultural setting" (Thompson, 1992, p. 127). This view puts principals' construction of meaning and teachers' construction of meaning in line with the problem-solving approach to mathematics in which "students engage in purposeful activities arising from meaningful problems requiring reasoning and creative thinking, gathering and applying information, discovering constructs, communicating ideas, and testing those ideas through critical reflection and argumentation" (p. 128).

An understanding of what comprises conceptions of mathematics teaching and learning, how they are measured, and how they might be subject to change has been the discussion of researchers studying teachers' knowledge and beliefs for over two decades (Philipp, 2007; Shulman, 1987; Tate & Rousseau, 2007; Thompson, 1992). However, the research related to principals is limited. The small body of research that does exist on principals' beliefs, knowledge, and ideas about mathematics teaching and learning (Buonopane, 2006; Burch & Spillane, 2003; Nelson, 1999; Nelson & Sassi, 2005; Stein & Nelson, 2003) uses constructs to frame the discussion of principals' conceptions that are similar to those presented in the teacher research, although these researchers most consistently use the terms "beliefs" and "mathematical understandings", rather than "conceptions".

For this study, I have chosen to use the term conceptions that was developed in the research with teachers, as defined by Thompson (1992): "a general notion or mental structure encompassing beliefs, meanings, concepts, propositions, rules, mental images, and preferences" (p. 130). Philipp (2007) notes that Thompson thinks of conceptions as including beliefs and knowledge. Both beliefs and knowledge are important for researchers to explore, since "to look at research on mathematics teachers' beliefs and conceptions in isolation from research on mathematics teachers' knowledge will necessarily result in an incomplete picture" (Thompson, 1992, p. 131). Beliefs are held with varying degrees of conviction, and are subject to change with new experiences and information, whereas knowledge is more fixed, associated with truth. This distinction becomes important because, viewed this way, teachers or leaders can disagree about beliefs but still find common ground because their beliefs are flexible. Change becomes more difficult when teachers hold notions as

knowledge – for example the notion that students are better served being taught procedures before concepts. “Real roadblocks to meaningful dialogue are created when at least one of a party of a disagreement holds a notion as knowledge . . .” (Philipp, 2007, p. 267).

This is not to suggest that beliefs are easily changed. Thompson (1992) found in her review of the research on teachers’ beliefs and their teaching practices that there are inconsistencies between teachers’ professed beliefs and their actual instructional practices, suggesting that they may have difficulties in accommodating new ideas into their existing paradigm of mathematics, teaching and learning. Educational researchers studying mathematics teachers’ and leaders’ beliefs and knowledge argue that the issue is not whether some conception is true in an ontological way, but rather how a teacher or leader views the conception (Philipp, 2007). Thompson (1984) reported on one study that looked at the relationship of teachers’ conceptions of mathematics and mathematics teaching to their instructional practices. She found high consistency between teachers’ professed conceptions and the way in which they presented content to their classes. Later studies (Pepin, 1999; Thompson, 1992) further substantiated that mathematics teachers’ classroom practices reflect their conceptions of mathematics and its teaching and learning. Teachers holding an instrumentalist view about mathematics and its teaching and learning are more likely to emphasize mathematics procedures through demonstration, teach mathematics as a set of objective and universal facts and rules to be memorized, and portray mathematics as an infallible discipline (Thompson, 1992). Since the teachers’ main objective is the learner’s mastery of mathematical skills, the “clear presentation of step-by-step procedures” (Golafshani, 2002, p. 6) and an emphasis on producing correct answers are likely to be practiced.

Teachers holding a problem-solving perspective of mathematics are likely to use an interactive mode of instruction that allows students to explore and investigate while teachers promote reasoning and inquiry by “posing questions and challenging students to think and reason” (Kitchen, Roy, Lee, & Secada, 2009). Reform mathematics is aligned with problem-solving pedagogy, which engages students in posing and solving problems, communicating their ideas, making and proving conjectures, and constructing concepts. Assessment shifts the emphasis from students producing correct answers to communicating and representing their thinking (Kulm, 1994). School mathematics in the problem-solving view aligns with a constructivist learning theory in which a community of learners engage in the study of patterns, solve problems, and create new understandings (Ernest, 1992).

Transforming practice must address teachers’ conceptions about mathematics, teaching and learning at a time “in which the instrumentalist view is dominant” (Thompson & Zeuli, 1999). And teachers may reflect multiple perspectives in their classroom instructional practices as they attempt to model practices or implement curriculum for which they do not have the conceptual knowledge or which conflicts with deeply held views (Kitchen, et al., 2009; Ma, 1999; Thompson, 1992).

Principals, too, have beliefs and ideas about how children learn mathematics and which instructional practices are most effective. Beliefs about mathematics teaching and learning influence how principals lead the reforms (Nelson & Sassi, 2005). Those leadership practices are included in a larger construct that has received much attention in the literature, and in which leadership for mathematics reform is imbedded – instructional leadership.

## **Instructional Leadership**

The literature on school improvement has produced an extraordinarily long list of responsibilities for school leaders. As Davis, Darling-Hammond, LaPointe, and Meyerson (2005) argue, “the role of the principal has swelled to include a staggering array of competencies” (p. 4), including visionary, disciplinarian, community builder, public relations manager, facilities manager, assessment expert, and instructional leader. But in an era of accountability, when student achievement is paramount and principals and teachers are held increasingly accountable for student performance on standardized tests, instructional leadership has become a key focus and a mandate. “With the passage of the federal No Child Left Behind Act (NCLB, 2002), many of these new roles have been written into law” (Brewster & Klump, 2005, p. 1). Under this law, principals are required to serve as “instructional leaders” in their schools, to “help students meet challenging academic achievement standards” (Title II, Section 2113, cited in Brewster & Klump, 2005). Principals are increasingly accountable for the test performance of their students. These stepped-up requirements have increased “pressure from school boards, community leaders, and parents to produce results, fast” (Brewster & Klump, p. 2). Central to the challenges of the leadership role is communicating a “sense of urgency and support to staff members around issues of standards and accountability” (Elmore, 2000, p. 33), and then buttressing those expectations with professional development and resources needed to implement high quality instruction.

School improvement and effective schools research identifies instructional leadership as one of the key conditions enabling schools with traditionally underperforming populations to perform at higher levels (Kitchen et al., 2007; Leithwood et al., 2004; Marzano, 2003; Reys, Chavez, & Reys, 2003). A number of researchers have studied the role of the principal

in the improvement of teaching and learning, which is characterized as *instructional leadership* (Davis et al., 2005; Waters & Grubb, 2004). Several meta-analyses of school improvement efforts (Marzano, Waters, & McNulty, 2005; Sebring & Bryk, 2000; Supovitz & Poglinco, 2001) have identified key strategies and essential leadership competencies that are associated with successful curricular reform. I have synthesized these analyses into six domains of practice that characterize instructional leadership and support a discussion of such leadership for mathematics reform.

An important caveat for the reader is that instructional leadership is a broad construct and is not a substitute for management. Research by St. John, Century, Eggers-Pierola, Houghton, Jennings and Tibbits (1999) suggests that schools must be well positioned to manage reform. Not every school is ready for the commitment to the school-wide efforts required when reform involves changes in everything from teaching practices to data-driven decision-making. Research in eight schools involved in a systemic reform initiative in mathematics found that a reform infrastructure (St. John et al., 1999) was needed to support implementation efforts. They found that basic constructs to that infrastructure were a stable and safe school environment; a focus on one major reform effort at a time; and access to resources of materials, time and expertise.

Suffice it to say that the research on educational leadership has produced a long list of “best practices” for transforming schools and the teaching and learning within schools. Leithwood et al. (2004) honed the list down to three essential leadership roles, without which change could not happen: set direction, develop people, and redesign the organization. These practices “can be thought of as the ‘basics’ of successful leadership . . . Without them, not

much would happen” (p. 6). What follows is a description of the three essential roles, pulling in supporting literature from various researchers.

**Set the direction.** Evidence across studies suggests that the leadership practices included in setting direction “account for the largest proportion of a leaders’ impact” (Leithwood et al., 2004, p. 6). Setting direction includes developing a shared understanding of what the school and instructional programs should look like and what needs to be done to get there. Instructional change requires a laser-like focus on improving student learning as the primary purpose of schooling (Fullan, 2007; Hallinger & Heck, 1998; Marzano, Waters, & McNulty, 2005; Supovitz & Pogliinco, 2001). Daily actions need to draw and sustain everyone’s attention to this purpose. These actions include modeling a community of inquiry about student thinking and instruction (Cohen & Ball, 1999; Nelson & Sassi, 2005); promoting best practices in content instruction; providing targeted staff development; and “staying on top of the myriad of day-to-day decisions that must be made about the schedule, assemblies, and parents’ meetings in order to maximize instructional time and resources for learning” (Sebring & Bryk, 2000, p. 9).

“The exponential value of instructional leadership comes from the marriage of an intense organizational focus on instructional improvement with a clear vision of instructional quality” (Supovitz & Pogliinco, 2001, p. 12). Effective schools research indicates that it is critical for leaders to have and convey a concrete vision of quality classroom instruction, including a tangible representation of effective instructional planning and delivery, with a deep understanding of standards-based teaching and learning in classrooms (Kitchen et al., 2007; Nelson & Sassi, 2005; Supovitz & Pogliinco, 2001; Wenglinsky, 2002). Supovitz and Pogliinco (2001) found that this understanding gave principals the ability to build school-wide

support for an expectation that standard instructional practices commensurate with reform would be consistently applied to classrooms over time. Nelson and Sassi (2005) found that principals with a deeper understanding of standards-based mathematics instruction were more likely to support it through their supervisory practices, including observing instruction, discussing student work and analyzing classroom discourse. The most effective leaders focus more on student work than on teacher behavior (Nelson & Sassi, 2005; Stein & Nelson, 2003). The challenge for principals is that this focus requires significant knowledge of content and pedagogy, and involvement in curriculum and instruction (Cotton, 2003; Fullan, 2001; Marzano et al., 2005; Nelson & Sassi, 2005). Because principals with strong instructional knowledge understand best instructional practices, they can directly supervise teaching and learning and can ask questions that encourage teachers to examine their instructional practices (Cotton, 2003; Nelson & Sassi, 2005).

In addition, the prescriptive literature suggests that effective school leaders collaborate with teachers to use relevant data in systematic ways to foster the improvement of programs (Fullan, 2007; Leithwood et al., 2005) as well as to track student progress both summatively and formatively (Cohen & Ball, 1999; Leithwood et al., 2005). This implies that teachers, too, will need training to make meaningful use of the data to inform their practice. Setting the direction for improving student proficiency in mathematics, proficiency that includes deep conceptual understanding, requires that leaders model best practices in data-driven decision making to guide instructional reforms. These new challenges have placed demands on principals to develop new skills in instructional leadership and data-driven decision-making (Winograd, 2006). Yet relatively little is known about what understandings and conceptions underlie principals' decisions and how they choose to act.



**Develop the people.** Targeted, sustained professional development to provide support for teachers' ongoing learning is arguably the most significant way for leaders to maintain a focus on mathematics reforms. Leithwood et al. (2004) point to three specific practices that help develop people: stimulate them intellectually; provide them with individual support; provide them with an appropriate model. The research on schools with effective reform efforts found that a key aspect to fostering an environment of improvement and inquiry is providing substantial targeted professional development support that is situated in practice (Cohen & Ball, 1999; Stein & Nelson, 2003; Reys, Chavez & Reys, 2003). Effective professional development means that teachers improve practice by investigating teaching and learning within classroom practice or "in situations derived from practice" (Cohen & Ball, 1999, p. 30). Many of the research-based instructional reforms are complex and cannot be reduced to an afternoon workshop or predictable routines (Cohen & Ball, 1999). A number of researchers have concluded that teachers need strong professional communities, or networks, where they can focus on issues central to classroom practice (e.g. Cobb & Smith, 2008; Kazemi & Franke, 2003) including "discerning the mathematical intent of instructional tasks and identifying the relative sophistication of student reasoning strategies" (Cobb & Smith, 2008, p. 6). This is a refinement of teaching that includes what Lampert (2001) refers to as "unpacking" students' thinking to get at reasoning and misconceptions.

The concept of communities of practice (Cobb & Smith, 2008; Marzano, Waters, & McNulty, 2005; Remillard, 2005) is prevalent in the literature on education reform. Teachers need time to read and examine a new curriculum with colleagues, "making their interpretations and decisions explicit to themselves and others (Remillard, 2005, p. 239). Instructional leaders create conditions for teachers to work collaboratively to develop

pedagogy and content knowledge (Fullan, 2007; Marzano et al., 2005; Spillane, 2002; Supovitz & Poglinco, 2001), which in turn, increases organizational capacity (Marzano et al., 2005). The National Commission on Teaching and America's Future (2003) concludes that quality teaching requires collegial interchange within on-going professional learning communities that share and are guided by research-informed best practices. Deprivatizing adult learning, practice and work to continually improve instruction must be shared and guided by research-informed best practices and pedagogy. However, it will be challenging to open the traditionally isolationist culture of education and to find the necessary time so that teachers observe other teachers, are observed by others, and participate in informed and telling debate on the quality and effectiveness of their instruction (Fullan, 2007). Fullan adds that this deprivatization will be much harder than most educators think because "it changes a culture of autonomy to one of collaboration" (p. 36). He suggests that punitive accountability structures have created an atmosphere of mistrust, which increases the challenges for principals. But to really change the quality of teaching and learning, "all teachers, the professional learning community. . . [must] embrace this demanding standard" (p. 36). One way to increase openness is to include teachers in the design and implementation of important instructional decisions and policies. This includes "distributing leadership responsibilities across the staff" (Supovitz & Poglinco, 2001, p. 10) to draw on others' expertise. Nurturing shared leadership means, too, that where individual administrators do not have "the requisite knowledge for the task at hand" (Stein & Nelson, 2003, p. 444), they can call upon the expertise of others within the school instructional staff to support the community of learners.

Reform includes risks for adult learners, as well as children and teachers, need to feel safe and encouraged to take risks, experiment, and continue learning, while being held accountable for implementing reforms (Cohen & Ball, 1999; Remillard, 2005; Stein & Nelson, 2003). This means a principal is able to supervise by “building more supportive relationships with teachers and fostering an environment that values the exploration and improvement of the craft of teaching” (Sebring & Bryk, 2000, p. 9).

Teacher communities of practice take vision and planning. They require access to resources, regular and consistent time to meet, and access to expertise. This implies the need for a systemic effort, an “infrastructure for reform” (St. John et al., 1999) and an organizational capacity to support lasting change (Darling-Hammond, 2000; Kitchen et al., 2007). Such capacity includes proper facilities, time to teach, standards-based materials, time for teachers to collaborate, stability in the administrative and teaching staffs and a focus on only one or two major initiatives, such as mathematics reform. In addition, these researchers have found that teachers require a culture of high expectations for ongoing learning, both through professional development and in-class modeling support. Without a systemic approach to change, random acts of improvement and excellence will continue; however, random change does not ensure access to high quality mathematics education for all students. Research on effective schools has shown that teacher communities of practice will be more likely to emerge and be sustained if the principal holds a vision consistent with reform views (Elmore, 1997; Marzano et al., 2005).

While effective leadership must provide supports for teachers to develop and refine their beliefs about and implementation of reform teaching strategies, there is another important instructional leadership component to insuring improved teaching practices at

scale. Cobb and Smith (2008) and Prestine and Nelson (2003) refer to this leadership role as “press”, or holding teachers accountable for implementing the reforms. Several researchers have written about the importance of leadership that understands the balance between high expectations and ensuring that teachers have the skills and materials to meet those expectations (Cobb & Smith, 2008; Cohen & Ball, 1999; Nelson & Sassi, 2005). Nelson & Sassi (2005) add that, along with adequate professional supports, teachers must be held accountable, through supervision, for the professional learning in which they engage. This style of supervisory practice requires a particular commitment from the principal. Meaningful participation in classroom instructional practices also means allocating regular blocks of time for instructional rather than managerial and political matters. “Scheduling meetings and doing paperwork outside class time sends a message that student learning is a priority” (Supovitz & Poglinco, 2001, p. 13). One principal in their study noted that, “if you don’t monitor, [standards-based instruction] slips” (p. 6).

**Redesign the organization.** Effective school leaders work within their schools to purposefully create organizational conditions that support and sustain the performance of everyone in the school community. In order to promote a culture focused on academic excellence, resources are required, including qualified staff, time to implement best practices and training, and material resources. Instructional leaders provide and manage resources, including personnel, materials, and time, in ways that enable teachers and students to be successful (Cotton, 2003; Hallinger & Heck, 1998; Marzano et al., 2005). Through careful stewardship and the creative use of resources, leaders are able to acquire and allocate research-based instructional materials and design professional training in the use and intent of those materials. They recruit and assign high-quality teachers, collaborate with staff to

provide adequate instructional time for core subjects, keep interruptions to a minimum, and arrange for instructional opportunities for students that extend beyond the regular school day (Cotton, 2003; Kazemi & Franke, 2003; Leithwood et al., 2004; Marzano et al., 2005).

The focus on instruction also includes protecting staff from distractions and intrusions during instruction (Marzano, Waters, & McNulty, 2005; Supovitz & Poglianco, 2001) and maintaining high expectations and a belief that all students can learn from a challenging curriculum (Hallinger & Heck, 1998; Marzano, Waters, & McNulty, 2005; Reys, Chavez, & Reys, 2003). This belief can be implemented by providing students with highly qualified teachers who provide a challenging curriculum. In other words, the culture of the school is focused on academic excellence (Hallinger & Heck, 1998), the achievement of which requires an orderly learning environment supportive of serious academic work (Cohen & Ball, 1999; St. John et al., 1999). St. John et al. refer to the environment that is necessary to support school-wide improvement efforts as a “reform infrastructure” (p. 4). A school with the right infrastructure is the school that has a “stable, clean communicative environment and has the interest and the desire to make the change” (p. 4).

### **Mathematics Reform and Leadership**

A discussion of the literature on principal leadership for mathematics reform must begin at the core of the work of schools – with teaching and learning. The literature on instructional leadership has informed the smaller body of literature that is specific to leadership and mathematics reform needed for the high achievement for all students (Nelson, 1998; Nelson & Sassi, 2005; Spillane & Halverson, 1998; Stein & Nelson, 2003). Marzano, Waters, and McNulty’s (2003) findings on instructional leadership imply that mathematics reform will require school leaders to conceive of the reforms, believe in the reforms, and act

to support them. In order to appreciate the challenges that school leaders face in supporting the reforms, it is important to appreciate that mathematics reform has meant “a fundamental reorientation of teaching and learning” (Cohen & Ball, 2006, p. 7).

**Mathematics reform – a paradigm shift.** The reform movement in mathematics is not new, having its beginnings in the early part of the 20<sup>th</sup> century. The National Council of Teachers of Mathematics (NCTM) was created in 1920 due to sharp criticisms of mathematics as a school subject at a National Education Association meeting in 1919 (Buonopane, 2006). When the Soviet Union launched Sputnik in 1957, reform efforts were renewed beginning with the curriculum. The reforms were intended to modernize content, but teachers considered them to be too abstract, confusing, and impractical. Thus reform receded, and the “back-to-basics” movement became the distinctive feature of textbooks and instructional programs (Van de Walle, 2004). As will be shown in the following paragraphs, this first failure of reform efforts was likely due to the very lack of support for teachers that researchers are now calling for.

In the late 1970s and early 1980s, the National council of Teachers of Mathematics (NCTM) and the National Council of Supervisors of Mathematics (NCSM) started to unite behind a call for a balanced approach to the teaching of mathematics, including problem solving, understanding, and application to real-life situations. Supported by critical national advisory reports, including *A Nation at Risk* and research done by NCTM, mathematics educators and mathematicians collaborated to develop the architecture for standards-based reform. Their recommendations for the improvement of school mathematics instruction and assessment were first articulated in the *Curriculum and Evaluation Standards for School Mathematics*, published by NCTM in 1989, which became the first “coherent vision to

significantly improve the teaching, learning, and assessment of mathematics” (Buonopane, 2006, p. 23). Over the next 10 years, research, revisions and updates were combined into a single book, the *NCTM Principles and Standards for School Mathematics*, (NCTM, 2000). All of these documents have denoted a shift in the focus of mathematics educators from an instrumentalist view that emphasizes skill development and sees mathematics as an external body of knowledge to be memorized (Cobb, Yackel, and Wood, 1992) to a standards-based inquiry approach that emphasizes problem solving and reasoning rather than mastery of procedures and facts (Nelson, 1999; Van de Walle, 2004). The later approach constitutes much of what NCTM (2000) calls standards-based reforms. The adoption of an inquiry approach to mathematics requires teachers to “see their role as posing questions and challenging students to think and reason” (Kitchen et al., 2007, p. 11). Researchers have found that students who are taught with pedagogy that emphasizes depth over content coverage, reasoning over memorization, and strategic competence over task completion outperformed students in more “traditional” classrooms (Newmann, Secada, & Wehlage, 1995; Kitchen et al., 2007). Yet many teachers continue to embrace an instrumentalist view of mathematics teaching (Romberg, 1992; Thompson, 1992), presenting mathematics as a “sequence of fixed skills or concepts . . . which seem necessary for subsequent learning” (Kitchen et al., 2007, p. 11).

This shift in the very ideas about the nature of learning and teaching mathematics, upon which traditional teaching practice has long been based, has significant implications and challenges for principals as instructional leaders (Nelson, 1999; Spillane, Halverson, & Diamond, 2004). In the effort to support new pedagogy and new curricula, new administrative practices must emerge. When fundamental ideas about teaching and learning in the content

area begin to shift, administrative practices can either act in concert with those changes or can maintain the status quo (Nelson, 1999).

*Challenges related to teacher beliefs and construction of new knowledge.* Efforts to transform mathematics teaching in schools must address teachers' beliefs and understandings about the teaching and learning of mathematics, including their own mathematical understandings. Construction in learning is not just in the domain of children, but of adults as well. Teachers are faced with a number of new learning challenges of their own: the demands of new technology in mathematics; pedagogy for enhancing students' problem-solving skills and critical thinking; forms of assessment that address how students are making sense of the mathematical ideas; and last, but certainly not least, their own need for broad and deep knowledge of mathematical content. To bring all teachers into a culture of mathematics education that employs an inquiry method and problem-solving approach, "mathematics educators must address teachers' deeply held conceptions in which the instrumentalist view is predominant" (Kitchen et al., 2007, p. 12). In a study to learn more about the mathematical knowledge of elementary school teachers in the US, researchers found that even teachers who favored a problem-solving approach felt they lacked conceptual mathematical knowledge, or "profound understanding of fundamental mathematics" (Ma, 1999, p. 124). Spillane and Zeuli (1999) found that, while teachers were often familiar with the NCTM standards and reflected at least some aspects of the reforms in their instruction, many had managed only to change behavioral regularities of instruction but not the epistemological regularities. They were essentially trying to "graft" new learning styles onto traditional teaching practices, leading the researchers to conclude, "while these teachers had behavioral moves that went against the grain of traditional practice, they had not challenged the



epistemological regularities that are the mainstays of traditional practice” (Spillane & Zeuli, p. 20). Additionally complicating reform efforts are teachers’ views of “sequentiality in subjects such as mathematics” (Burch & Spillane, 2003, p. 520), leading to resistance to curricula that are organized thematically. As Saxe, Gearhart, & Nasir (2001) note, “Although good curriculum materials can provide rich tasks and activities that support students’ mathematical investigations, such materials may not be sufficient to enable deep changes in instructional practice” (p. 56). Enthusiasm for the current era of reform must be tempered by the field’s growing awareness that change in practice is neither quick nor easy for teachers. Spillane and Zeuli (1999) conclude that policy makers and reformers (and as brokers, principals) must be concerned with assisting teachers in constructing new understandings and developing new meanings for existing practices. To do so, structures must support teachers’ understandings of reform ideas, and reform efforts must support teacher learning. Without this more complex conception of the need to address teachers’ understandings and underlying belief systems, “teachers will tend toward low-level responses aimed at complying with requirements while not changing practices or beliefs significantly” (Conley, 2003, p. 92).

Another significant challenge to reform efforts for both teachers and administrators is the issue of fidelity to the adopted curriculum. How often teachers use the lessons, and how they cover the lessons methodologically are challenging questions. Research by Reys, Reys, Tarr, & Chávez, (2006) has shown that teachers tend to implement the new curricula to varying degrees, with different interpretations of the intent and with selective use of the lesson components (Remillard, 2005; Reys et al., 2006). They found that each teacher used the curriculum materials differently, and most teachers supplemented it with skill-building and practice worksheets. Reys et al. also found that even within a single school building,

decisions regarding the selection and emphasis of mathematics content resulted in striking differences in students' opportunity to learn. Other researchers have documented the importance of implementing mathematics curricula in a manner consistent with the program philosophy (Cohen & Ball, 1999; Remillard, 2005), yet clearly this is not the pervasive practice.

Researchers have discovered that, while many teachers believe they successfully implement the reform curriculum and employ instructional practices that are aligned with reforms, in reality they may only make superficial changes, such as grouping students or using manipulatives (Remillard, 2005; Spillane & Zeuli, 1999). This means that the practices more relevant to reform, such as expecting students to justify solutions or developing student reasoning through questioning strategies, often do not get implemented. As long as school and district policies reinforce teacher autonomy and a sense of individual control over what happens in the classroom, “striking differences in students' opportunity to learn, even within a single building” are likely to continue (Reys et al., 2006, p. 11). If leadership expectations are, indeed, the catalyst for change, the implicit requirement is that school leaders know what it looks like to implement those expectations with fidelity, and are willing to hold teachers accountable for implementing what they have learned in professional development.

Advancing reform ideals pedagogically involves substantially new learning experiences for many teachers. Therefore, it requires that teachers receive long-term, sustained professional support throughout implementation – experiences that are rooted in teachers' current classroom practices, involve extensive support and provide multiple opportunities to experiment and reflect (Kazemi & Franke, 2003; Spillane, 2002; Spillane & Zeuli, 1999). Systematic, long-term development that allows practice – and reflection on that

practice – is required, and must include the development of teacher content knowledge (Hill, Rowan & Ball, 2005; Manouchehri & Goodman, 2000).

*Content knowledge for teaching.* This notion of teacher content knowledge is important to explore as contextual research surrounding leadership practices in mathematics because it has implications for the hiring, the supervision, and the support of teachers through professional development and teacher networks (Cobb & Smith, 2008). The premise of content knowledge for teaching that good teaching is more than knowledge of content was brought to the forefront by Shulman (1987), who coined the term “pedagogical content knowledge” or PCK. PCK is “the blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction” (Shulman, 1987, p. 8). More recent research by Ball & Bass (2001) and Ball, Thames & Phelps (2007) has focused on “content knowledge for teaching,” which theorizes that there is “a domain content knowledge unique to the work of teaching” (Ball et al., 2007, p. 46) This construct gives primary importance to knowledge of disciplinary content, knowledge of student thinking about content, and content knowledge of instructional strategies.

Implementing this kind of instructional change is complex, and the process cannot be reduced to an afternoon workshop or predictable routines (Cohen & Ball, 1999). A number of researchers have concluded that teachers need strong professional communities, or networks, where they can focus on issues central to classroom practice (Cobb & Smith, 2008; Franke & Kazemi, 2001) including “discerning the mathematical intent of instructional tasks and identifying the relative sophistication of student reasoning strategies” (Cobb & Smith, 2008, p. 6).

***Leadership for mathematics reform.*** The prescriptive and empirical literature presents some common themes associated with principals' support for standards-based reform of mathematics education (e.g. McEwan, 2000; Nelson & Sassi, 2005; Spillane, Halverson & Diamond, 2004). These ideas include principals' beliefs and knowledge about the teaching and learning of mathematics, principals' efforts to encourage meaningful collaborations among teachers, and the principals' efforts to keep attention focused on the reform initiatives. Nelson, Stimpson, Jordan (2007) found that administrators' understanding of high quality mathematics instruction and their ideas about how they can support it "are significantly influenced by their ideas about the nature of mathematics, teaching, and learning." In their research with school principals, Stein and Nelson (2003) state:

Principals must not only be capable of providing professional development for their teachers, but also have the knowledge, skills, and strength of character to hold teachers accountable for integrating what they have learned in professional development into their ongoing practice. (p. 428)

***Leadership Content Knowledge.*** Most of the prescriptive literature concerning principals' conceptions and beliefs about mathematics teaching and learning focuses on increasing their knowledge about the reform of mathematics education. In a discussion of what principals should do, McEwan (2000) explains what reform mathematics education entails, including its pedagogical premises. However, much of it is the same broad prescriptive language of the "effective schools" research of the 1980's, advising leaders to "establish clear instructional goals . . . communicate the vision and mission of your school. . . . set high expectations. . ." (p. 91). Supervising pedagogy came to mean "look fors" during classroom walk-throughs, focused on the form of instruction rather than the function. Form-

focused understandings, as articulated by Saxe (2001), refer to pedagogical moves, including grouping arrangements, instructional materials and student work. Were students in small groups? What was on the walls? Was the teacher giving sufficient wait time? Small group work and hands-on activities can “miss the mathematical mark” (Nelson & Sassi, 2006, p. 135), failing to connect student thinking with the mathematical ideas and problem-solving strategies that these instructional forms are intended to illuminate. Without deeper understanding of the functional understandings, such as what counts as mathematical knowledge and doing mathematics, in which problem-solving mathematics classrooms and curricula are founded, principals are not likely to look for student misconceptions and teacher questioning strategies (Nelson & Sassi, 2005; Saxe, 2001). Yet these are the very behaviors and practices that the reform problem-solving approach calls for (Ball, 2004; Ellis & Berry, 2005).

The construct of leadership content knowledge (LCK) (Nelson & Sassi, 2005; Stein & Nelson, 2003) that helps to frame this study, as presented in Chapter 2, suggests that LCK shapes leaders’ concerns in the actual practice of classroom observation and teacher supervision. These researchers propose that administrators’ leadership content knowledge, “their knowledge of the subject matter of instruction, and beliefs about how it is learned and how it is effectively taught” (Reed, Goldsmith & Nelson, 2006, p. 1), determines their effectiveness as leaders in improving mathematics’ instruction. By working with school leaders, they found that principals are particularly challenged in learning to observe for a combination of form (content, tools and pedagogy) and function (focusing on students’ mathematical understandings). In their work with principals over several years, they found three significant challenges for principals related to their LCK: learning to attend to the

mathematical content of students' thinking; using their own mathematical knowledge to make an assessment of conceptions and misconceptions; and analyzing how the teachers' instructional moves promote students' mathematical thinking. They found that these were very different foci than most principals had previously targeted (Nelson & Sassi, 2006). These findings were similar to those presented in a study by Spillane (2000), who found that district leaders tended to focus on the use of manipulatives, group work and student discussion rather than on the development of conceptual understanding. "District leaders, failing to construct function-focused understandings, shifted the focus of the mathematics reforms to a reconfigured means to a familiar end, instead of enabling students to grapple with principled mathematical knowledge" (Spillane, 2000, p. 154).

These researchers all found that principals seemed to be able to accept the surface-level changes of classroom pedagogy, but were still grappling with core beliefs about what it meant to teach and learn mathematics. Principals could fairly quickly accommodate new ideas about "form" or behavioral aspects of teaching, expanding their LCK to include small group work and students' explanations of their problem-solving strategies. They also found that principals required opportunities to develop new conceptions of reform pedagogy through professional development in order to move toward a focus on both form and function (Reed et al., 2006).

In another study that helps to support the theory of leadership content knowledge and principal conceptions, Burch and Spillane (2003) found that distinct views of literacy and mathematics teaching and learning were demonstrated through leadership practices. Principals in their study viewed mathematics as a highly defined body of knowledge (subject level), and thus believed that learning the pedagogy required formal expertise and training

from outside experts, as well as highly sequenced mathematics curricula. In contrast, those principals viewed literacy as requiring less expertise and believed that teachers could help each other learn what was needed. Burch and Spillane (2003) also found that by observing teachers, analyzing student work, and meeting with small groups of teachers to discuss their practice, leaders learned about the complexities involved in instructional reform in mathematics, which is related to the professional learning level of the LCK construct. They argue that what leaders do to improve instruction, as well as what they do in terms of support and professional development, depends partly on the subject matter, but that appropriate strategies emerge through their leadership practice, as well. “Involvement in instructional reform activities seemed to help leaders learn new things about the role of school supports in mathematics” (Burch & Spillane, 2003, p. 532). Nelson and Sassi (2005), in their investigation of leadership content knowledge, worked with principals who chose to be involved in pilot courses in elementary mathematics instruction. They found that principals’ participation in such professional development prompted them to examine their own knowledge and beliefs about mathematics teaching and learning.

Leaders’ attempts to respond to the new challenges of the implementation of reform mathematics teaching and learning can be influenced by leaders’ own sense-making (Burch & Spillane, 2003). They make sense of and generate new perspectives on improving instruction in mathematics in the course of visiting classrooms, analyzing student work, listening to students and parents, and meeting with groups of teachers to discuss their teaching and their concerns. They also make sense of the pedagogy as they interpret the pressures of outside policies, such as NCLB accountability mandates, standardized testing, curriculum adoption and supervision requirements (Spillane, Reiser & Reimer, 2002).

**Leadership and mediating state and district policy for reform.** In the process of implementing mathematics reforms, principals must mediate policy, as represented through verbal and written media, including legislation, directives, and curriculum intent. “Although policies cannot construct understanding for implementing agents” (Spillane et al., 2003, p. 414), the delivery of the policy message and the “weight” of the message influence principals’ sense-making efforts. Research highlights three key policy areas that are important for mathematics reform: the accountability demands for improving student achievement on annual standards-based assessments (Howley et al., 2007; Remillard, 2005), the policy messages about curriculum integrity (Remillard, 2005), and district policy directives related to teacher supervision (Downey, Steffe, English, Frase & Poston, 2004; Nelson & Sassi, 2005).

The impact of NCLB cannot be overlooked when considering how contemporary principals conceptualize their roles as leaders and practice those beliefs in their individual schools. Accountability demands and the need to improve student achievement in reading and mathematics filter into the daily work of school leaders and classroom teachers. As Daresh (2006) states:

[. . .] the most powerful mandate for focusing on educational accountability was clearly the passage of the No Child Left Behind Legislation in 2002. Since that time, the life and duties of school administrators and supervisors has changed drastically. (p.172)

Under pressure to reform, many districts and schools select mathematics curricula that relate closely to the state assessments used as accountability data (Howley et al., 2007). Many school districts seek curricula that are aligned with mathematics standards adopted



from a state framework (Tate & Rousseau, 2007). Students are all held to the same state standards, as required by NCLB, standards, which are closely linked to accountability systems and computerized feedback systems (National Research Council, 2001). Tate and Rousseau point out that students' opportunities to learn mathematics "are influenced by the assessment policies of the school district" (p. 1222), and assessment policy can be a driver for teacher pedagogy in the classroom. Despite the problem-solving stance incorporated into the new standards-based mathematics curricula, the changes many schools make in response to demands for increased student achievement can include ability grouping and an increased emphasis on classroom testing (Rowan, Harrison, & Haves, 2004). Howley et al. (2007) found that principals in rural schools often felt pressed to provide individualization for struggling students, leading to special intervention classes and tracking. Celedón-Pattichis (2004) warns that when making decisions to place ELL students in mathematics, "educators should ask whether they are measuring content knowledge or language proficiency" (p. 178), so educators do not underestimate students' mathematical abilities. Even in the early grades, "teachers and administrators need to advocate for ELLs in their initial placements because these placements tend to follow students for the rest of their academic lives" (Celedón-Pattichis, 2004, p. 188).

Bennett (2002) suggests principals can "avoid the shock of a single test results if they learn how to use a range of performance measures that can inform and assist in decision making throughout the year" (p. 3). Lipsitz, Mizell, Jackson, & Austin (1997) write that data-driven decision making is a necessary element of reform. They assert that "to be productively reflective and analytical, schools must have access to facts—to data—that illustrate the extent to which reform strategies are actually being implemented and the extent to which

implemented reform strategies lead to desired outcomes" (p. 536). Leadership is essential in developing a culture of inquiry for data-driven decision-making. Unfortunately, research by the New Mexico Office of Educational Accountability found that only 28% of principals felt prepared to deal effectively with data (Winograd, 2005). The level of principals' data interpretation skills will influence the accuracy of their analyses, the way they share data with teachers, and their capacity to infer reasonable next steps for improvement. Leithwood et al. (2004) identify the critical importance of skilled leadership in data-driven decision-making in the following paragraph:

Key actions of leadership for a culture of inquiry include: marshalling the community to a collective sense of purpose about improving student learning and to the vision that data use can and will improve learning; aligning data use to decision-making and planning processes; bringing data together with professional judgment, and creating time for data analysis and reflection. A culture of inquiry is characterized by respect for data, perseverance in pursuing investigations with data, and ownership of the data and the decisions that are made based on the data. (p. 8)

In this context, principals act as brokers between the district expectations for accountability and teachers' ability to use accountability data to inform their teaching, as well as the use of assessments to drive instructional and student placement decisions. As Howley et al. (2007) suggest, rather than making modest changes in order to respond to accountability mandates, data-informed teaching can help "institutionalize" the reforms.

A second policy representation related to mathematics reform efforts comes from the district or school level. This is policy, or lack of, that dictates curriculum fidelity. Many districts have adopted a standards-based curriculum, only to discover that putting the

materials in schools was not sufficient to improve student learning. This refers back to the critical role of professional development and curriculum integrity, for, as Briars and Resnick (2000) state:

It is widely agreed that standards, assessments, and accountability can raise achievement only if they motivate and enable better teaching – presumably the result of *curriculum* that is aligned with the standards and assessments, along with improved professional development for teachers and administrators. (p. 1)

These authors conducted a three-year study in the Pittsburg schools, and found that standards-based instructional materials were most effective when coupled with rigorous content and performance standards, standards-based assessments, and standards-based professional development. They also learned that principals must be willing to “confront” those teachers who were not fully implementing the program, and offer increased support to help them be successful (Briars & Resnick, 2000), for it is site-based administrators who have consistent access to teaching practices.

A third area of policy that principals must mediate is district directives related to supervisory practices. One supervisory practice currently receiving much attention that districts are adopting is the classroom walk-through. This method was developed to “replace the infrequent, formal “dipstick model of evaluation with very frequent, short, informal exchanges between principals and teachers” (Downey et al., 2004, p. xi). Most classroom walk-through models encourage principals to ask questions designed to promote reflective teaching practice: Is the work of my teachers aligned with the district curriculum? Are teachers using research-based teaching strategies? Do student grouping patterns support learning? Do students understand their goals for learning? Are students learning both basic

and higher order levels of knowledge? Considering these questions suggests a level of sophistication on the part of the principal. She must know the district curriculum at a glance, know research-based best practices for teaching mathematics, and learn to look for student thinking. Principals must understand what to look for and the purpose of their observations. Principals who are oriented toward attending to teacher behaviors considered to be good teaching, “derived from the process-product school of research on teaching” (Nelson & Sassi, 2005, p. 73) are likely to focus more on surface features of classrooms. Even if the orientation is toward constructivist teaching, focusing on teacher behaviors may miss the important mathematical ideas of students, which must be at the center of the teacher’s pedagogical processes. In order to have constructive collaborative conversations with teachers about what is going on in the mathematics classroom and make valid judgments about the quality of instruction, principals “need to attend to both the mathematical ideas in play and the teacher’s behaviors” (Nelson & Sassi, 2005, p. 74). Without leadership content knowledge to support the observation process, the walk-throughs can become evaluative and may be threatening to teachers. Even with LCK, principals find it challenging to find time to spend in every classroom each week, to actually interpret what is actually going on for students in the classroom, and to give teachers supportive and guiding feedback. This supervisory practice is a skill to be learned, practiced, reflected upon, and revised over time (Downey et al., 2004; Nelson & Sassi, 2005). Coupled with new learning about the mathematics reforms, this adds a considerable amount to a principal’s proverbial plate.

**Leadership for equity: Ensuring opportunity to learn.** When the revised *Principals and Standards for School Mathematics* (NCTM, 2000) were unveiled, the equity principle was front and center. It states, “Excellence in mathematics education requires

equity – high expectations and strong support for all students” (p. 12). In 2008, in an NCTM News Bulletin the original equity principal was elaborated upon with a statement that effective teaching of mathematics goes beyond content knowledge and management skills to include “developing and nurturing student, family, and community relationships” (Gutierrez, Bay-Williams, Kanold, 2008, p. 1). The authors suggest that effective teachers and leaders “infuse their instruction with culturally relevant and engaging mathematics tasks that are rigorous yet accessible” (p. 1).

Issues of access to a rigorous curriculum, culturally relevant mathematics and opportunities for students to express their mathematical thinking along with reform mathematics were part of the educational context that principals must broker. In fact, the No Child Left Behind Act has forced schools to address their culturally and linguistically different subpopulations (NCLB, 2002). Just as NCLB accountability measures brought instructional improvement in mathematics to the forefront, the mandates also managed to highlight the poor performance of the subgroups mentioned earlier – minority students, low-income, students and ELLs. NCLB legislation has set a very ambitious goal to have *all* students meet or exceed standards in mathematics by 2014, including each of the various demographic subgroups. According to the National Assessment for Educational Progress 2007 (National Center for Educational Statistics, 2007), only eleven percent of Hispanic 8<sup>th</sup> graders are proficient in mathematics and are “more than twice as likely to be undereducated than all groups combined” (Chavkin, 1993, p. 1). The educational vulnerability of Hispanic students is significant. Statistically, they start kindergarten behind their peers. By age thirteen, 44% are at least one year below expected grade level, and only 53% of Hispanic students graduate from high school (National Center for Educational Statistics, 2007).

Given the increase in the number of ELL students by 105% over the last ten years (National Clearinghouse for Bilingual Education, 2000) and the current emphasis on high-stakes testing, school leaders are challenged to find ways to support teachers to create improved mathematics instruction that “builds on students’ cultural experiences and language” (Celedón-Pattichis, 2004, p. 179). Celedón-Pattichis offers some examples of how to address issues of culture and language in the mathematics classroom, including making accommodations such as “extending the time for major exams and allowing the student to use their notes written in [their native language]” (p. 177). Furthermore, “mathematical objectives should be cognitively demanding and grade appropriate. Language-related adjustments and modifications should be made. . .” (p. 115). The challenge for teachers, over and above learning new content knowledge for teaching, is learning strategies that allow students to access the language of mathematics that is necessary for developing mathematical ideas.

The NCLB legislation of 2001 has served to make student achievement more transparent to the public and to highlight trends like the low performance in mathematics of Latino/as, African Americans, and Native Americans. The accountability demands of NCLB have drawn national attention to concern over improving educational outcomes for *all* students. Schools are now held accountable for adequate yearly progress goals (AYP) for students in eight subgroups, including five ethnic subgroups, special needs students, Free and Reduced Lunch (FRL) students, and English Language Learners (ELLs) (NCLB, 2001). District and state leaders are holding principals accountable for student achievement and AYP, as defined by the numbers of students who meet proficiency on standards-based assessments. When assessment, class placement, and graduation data indicate that minority

students or English Language Learners (ELLs) are dramatically underperforming (NCTM, 2005), school leaders are being asked to address bringing these students to proficiency through reforms in instructional practices, which must be specified in their school improvement plans (NMPED website).

What NCLB legislation does not change is the “framework of inequities” (Khisty, 1995) that assumes the problem resides in factors related to cultural deficits, pinpointing what students do not know mathematically or linguistically or culturally. One result of this framework is that, rather than changing the instructional practices to address the language and cultural needs of the students, schools default by remediating. If a student is unable to meet the assessment requirements, he or she is placed in remedial classes, and by middle school that can have dire consequences, including not passing through the gatekeeper of algebra into high school mathematics required for graduation (Flores, 2007). However, a number of researchers look at the problem of inequity in a fundamentally different way (Flores, 2007; Khisty, 1995; Moll & Diaz, 1987; Wenglinsky, 2004). These researchers suggest reframing the problem in terms of opportunity gaps that affect the poor achievement outcomes of many Hispanic and ELL students. They see a systematic process of school failure that involves inadequate instruction and lowered expectations for Hispanic and ELL students. Desimone, Smith, Baker & Ueno (2005) found that teachers in the U.S. tend to teach computational skills to a far greater degree than conceptual understandings to struggling and at-risk students. Flores (2007) suggests that shifting the frame from “looking at measures of educational outcomes to examining what students actually experience in schools” (p. 4) would refocus attention from the students to issues of access. African American and Hispanic students are less likely than White students to have access to

“teachers who emphasize reasoning and non-routine problem solving” (Flores, 2007, p. 4).

Two recent large-scale studies help illuminate the impact of instructional practices on student performance. Cohen and Hill (2000) conducted a large study throughout the state of California and found that in minority-majority classrooms where teachers emphasized higher order thinking skills, student mathematics performance improved. Another study by Wenglinsky (2004) found that an emphasis on higher-order thinking skills plus hands-on learning activities positively correlated to student mathematics performance. Basically, within-school achievement gaps “differ both between classes in the same school and between students in the same class” (Wenglinsky, 2004, p. 5). The implication is that instructional practices really can affect the achievement gap within a school – what teachers do in the classroom makes the difference.

There are several research studies that shed light on exactly what those classroom practices are. The first relates specifically to mathematics instruction of English Language Learners, which is a particular interest of this dissertation research. Researchers have focused on the nature of teachers’ language use in the instruction of mathematics (Khisty, 1995; Moschovich, 2007). Language use can mean clarity of wording or it can mean choice of languages – Spanish or English. The use of the primary language is often critical for ELL students in order to avoid confusions, particularly when Spanish is used at home by the adult helping the student with homework. Language usage also extends to the idea of the mathematics register (Khisty, 1995). This register is comprised of a set of unique everyday words whose meanings and structures change when used in the context of mathematics; for example, table, carry, point, left. Teachers must become very conscious of the discourse of mathematics in order to scaffold students’ mathematical understandings.



Other researchers have learned the value of culturally relevant pedagogy: adding more culturally relevant content, enhancing the social dimension by adding more authentic mathematics problems involving peer collaboration, and re-ordering activities to build on children's everyday knowledge (Boaler, 2004; Brenner, 1998; Celedón-Pattichis, 2004). Recent research indicates that standards-based reform curricula and a problem-solving approach to instruction are effective particularly with students of color. Students in Massachusetts using the Everyday Mathematics curriculum (Riordan & Noyce, 2001) performed better on standardized tests than did students taught with a more procedural curriculum. Boaler (2004) found similar results in her research with students at Railside School who were taught with a problem-solving approach that also acknowledged the value of the knowledge children bring from home, and demonstrated to students the meaningfulness of mathematics in everyday life.

Pockets of excellence in culturally and linguistically sensitive mathematics instruction have taught us what can be (Boaler, 2004; Kitchen et al., 2007). Kitchen et al.'s study on effective schools demonstrates that it is possible to improve mathematics achievement for poor minority students at scale. Principals and their schools really do have the power, by learning and emphasizing these best practices, to improve achievement for traditionally underachieving populations. The challenge for teachers, over and above learning new content knowledge for teaching, is learning strategies that allow students to access the language of mathematics that is necessary for developing mathematical ideas. The challenge for school leaders is conceiving of the possibilities, building the vision for what reform mathematics teaching and learning looks like, orchestrating the teacher networks and

professional development to support teachers to change, sustaining the “pressure” of high expectations, , and holding teachers accountable for reforms (Leithwood et al., 2004).

School and district leaders also have roles in the recruitment and hiring of highly qualified teachers. In a large national study of schools serving ELL students across the country, Cohen, Deterding and Clewell (2005) found that teachers in high ELL schools are more likely than those in other schools to be on emergency or provisional waivers and far more likely to be uncertified. These authors suggest one reason for the difficulty in recruiting highly qualified teachers is that schools with high ELL populations are often also high poverty schools (Cohen, Deterding & Clewell, 2005). This perception may be attributed in part to the fact that schools with large numbers of ELL students have been shown to fall disproportionately into their states’ low-performing category (Escamilla, Mahon, Riley-Bernal, & Routledge, 2003).

**Navigating mathematics reform in the unique school social context.** Spillane, Reiser & Reimer (2002) suggest “individuals draw on existing reservoirs of individual and collective knowledge” (p. 406) to make sense of policy and implementation practices. Thus interpretations of policy evolve within the context of school environments, and the meaning of the policy message can shift. Social interactions can shape sense-making about reform policy and about the reforms themselves. In a study by Coburn (2001), teachers affiliated with different groups within one school made different sense of the same policy messages about reading reform. Older, more experienced teachers favored direct instruction, while new teachers favored more progressive ideas about teaching. Another study by Cohen and Ball (1999) found that teachers with limited opportunities to talk professionally with each other

about their teaching practices interpreted very different meanings about revising their practices on the basis of the recommended reforms.

Another aspect of school social context that contributes to sense-making about the reforms, as well as sustaining the reforms, is the professional culture. The literature on reform suggests that a critical factor in supporting the professional learning that is required to change teaching practices is well-facilitated professional learning communities (see Gamoran et al., 2003). “It seems unlikely that even the most dedicated teachers will be able to sustain the resources and commitment necessary for teaching for understanding by themselves” (p. 19). These researchers found that sustained collaborative communities rooted in professional relationships that are part of the social framework *before* the introduction of reforms were more successful. These prior relationships had several important characteristics, including mutual trust “on which the members could draw to sustain engagement and resolve conflict” (p. 133); a sense of shared purpose; and the presence of professional dialog related to issues of teaching and learning. Leadership is required to ensure successful professional learning communities and to generate the resources needed to sustain their activities.

Situational context also involves what Spillane et al. (2004) call tacit knowledge, knowledge “actively acquired through participation in a culture” (p. 410) that informs how a person acts in certain situations. This can refer to traditions and beliefs that have existed in the school community for long periods that may be barriers to change. If traditionally, parents and teachers are happy with procedural mathematics, ability grouping, or even teacher choice, it may be difficult for leaders to negotiate reforms (Spillane et al., 2004).

School contexts influence how issues of diversity and equity are addressed. Quiroz and Secada (2003) report that teachers define these issues “in terms of their particular

experiences and the problems of their particular student populations” (p. 88). According to Gamorran (2005), educational equity can be described as “the organization of policies, resources, and opportunities that enable students to utilize their cognitive and social abilities in order to become upwardly mobile” (p. 89). If the goal of deep conceptual mathematics understanding for all is to be achieved, teachers must be supported to help students develop social conventions, roles, and responsibilities that create a safe and stimulating environment for problem-solving for each and every student.

### **Conclusion**

The challenges outlined above are perceived by many principals as overwhelming. According to research conducted on mathematics reform in rural schools, principals complained that instructional reform in mathematics was a complex job that was “fraught with challenges . . . added on top of their already heavy and complicated workloads” (Larson & Howley, 2006, p. 86). This view is alluded to in much of the literature, as principals lament the strains of their increasing responsibilities for student outcomes and school management (Brenninkmeyer & Spillane, 2004; Marzano et al., 2003; Waters & Grubb, 2004).

The message of the current research findings on the role of principal leadership in successful implementation of mathematics reform for improved student outcomes appears to be summed up by the National Staff Development Council:

Quality teaching in all classrooms necessitates skillful leadership at the community, district, school, and classroom levels . . . These leaders make certain that their colleagues have the necessary knowledge and skills and other forms of support that ensure success . . . These leaders read widely, participate in learning communities,

attend workshops and conferences, and model career-long learning by making their learning visible to others. (2001, p. 8)

In the face of the many challenges that accompany the reform of mathematics teaching and learning to improve opportunities and achievement for all students, it is important to understand how principals participate. Research has been done highlighting a need for instructional leadership that provides both support to teachers for new learning and the press to implement the reforms. Research on LCK also suggests that principals' leadership actions are influenced by their conceptions – their beliefs and knowledge about the discipline of mathematics and the teaching and learning of mathematics (Nelson & Sassi, 2005). Recently, researchers have suggested principals' conceptions, their ideas and beliefs about mathematics teaching and learning, are influenced, as well, by policy messages and by the social context of their schools (Cobb & Smith, 2008; Spillane et al., 2002). However, although studies have explored school leadership related to mathematics reform, few have sought to learn how principals conceive of the challenges, and of those, none have been situated in predominantly Hispanic-serving schools.

In order to support principals in leading the reforms, it will be important to learn more about their beliefs about providing opportunities for traditionally underperforming students to improve and excel in mathematics. The following chapter outlines a research design that will allow me to probe more deeply into the beliefs and knowledge of three principals at predominantly Hispanic schools.

## **Chapter 4: Research Design**

The purpose of this dissertation study was to contribute to the body of knowledge on the role of principal leadership in mathematics reform. More specifically, the study explored the complex and critical role of principal leadership, seeking to answer the question:

How do principals in predominantly Hispanic-serving schools conceive of their leadership roles in the implementation of a district-wide mathematics reform initiative?

In this chapter, I present a detailed explanation of my research design, including the mode of inquiry, site and participant selection, the conceptual framework that guides the design of the research and the analysis of the data. In addition, I explain the methods of data collection and analysis. I conclude the chapter by addressing my role as a researcher, as well as issues of validity and researcher ethics.

### **Mode of Inquiry**

The methodological tradition that framed this inquiry was the qualitative case study. The research aimed to learn about conceptions of leadership in mathematics reform through the voices of principals, within the context of their own lived experiences (Stake, 1995). Specifically, it was a “collective case study” (Creswell, 2007, p. 75) because I focused on multiple cases, set in predominantly Hispanic schools, which promised a rich and robust picture of leadership in mathematics reform. Case study research emphasizes detailed contextual analysis of a limited number of events and their relationships within bounded systems (Stake, 1995; Yin, 1994). Yin (1994) further defines case study as “an empirical inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between phenomenon and context are not clearly evident; and in which multiple

sources of evidence are used” (p. 23). The phenomenon, or experience, explored in this study was leadership related to mathematics reform in schools with large Hispanic and ELL populations. The cases, or bounded systems, were principals in their schools, and their conceptions of their roles in the reforms. Multiple cases strengthen the results through the use of a replication strategy (Yin, 1994), which is like conducting a number of separate studies on related topics. This approach was helpful in highlighting different perspectives on the issue of leadership in mathematics reform. Using multiple cases allowed for the provision of a detailed description of each case, or “within-case analysis” (Creswell, 2007, p. 75), which then allowed for the analysis of themes across cases. This project employed both within-case and cross case analysis, with an eye toward understanding the complexity of leadership that addresses conceptions of the mathematics reform initiatives, accountability demands, and opportunity to learn. The case studies can bring to light the fundamental connection between principal leadership and instructional practices in mathematics, as well as provide a basis for understanding how the participants broker policies within their individual school contexts.

This mode of inquiry is in line with a social constructivist epistemology espoused by Denzin & Lincoln (2000), who claim, “qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret phenomena in terms of the meanings people bring to them” (p. 3). My interest was in developing a deeper sense of how these principals’ beliefs and understandings about the teaching and learning of mathematics, in reciprocity with their unique school setting and the policy demands of the larger educational context, resulted in conceptions of their leadership roles.

The study was primarily from an interpretive lens, concerned with these principals’ “social construction of reality” (Ernst, 1999; Vygotsky, 1986) as they lived the day-to-day

challenges of implementing a standards-based mathematics program in their schools, amid social, cultural, fiscal and other contextual factors. As Merriam (1998) suggests, “qualitative researchers are interested in understanding the meaning people have constructed, that is, how they make sense of their world and the experiences they have in the world” (p. 5). To deepen our understanding of principals’ ways of interacting with mathematics reform we need to listen to their stories and voices, paying special attention to how they are “entangled with the social and historical context of their experiences” (Musanti, 2008, p. 27). One of the goals of the research was to understand how principals made sense of the complex issues central to mathematics reform. Guiding the design of the study and the analysis of the findings was a view that principals’ notions about leadership to improve mathematics teaching and learning is a social construction involving three systems: their beliefs, understandings and knowledge about mathematics, teaching and learning; their interpretation of policy representations related to mathematics reform; and the social context of the school they lead.

### **Site and Participant Selection**

The three school sites selected for this research were in a district that was chosen for three key reasons. First, it was a relatively small district in the southwest United States, comprised of approximately 8,500 students. The smaller size allowed for a greater understanding of the district context in which the reform policies were unfolding. Second, the district’s student population was 63% Hispanic, ensuring I would have access to predominantly Hispanic-serving schools. Finally, the year prior to the beginning of this study, the district had begun efforts to address the fact that only 22% of 8<sup>th</sup> grade students were proficient in mathematics on the state standards-based assessment. They enacted several policies aimed at improving mathematics instruction, the most significant being the adoption



of standards-based reform mathematics curricula district-wide for the 2007-2008 school year. This gave an important and consistent research parameter to the study. An additional characteristic of this district was its focus on data-driven decision making. Principals were required to keep detailed records of both standards-based assessment data and interim assessment data by school, by grade and by classroom. The district accountability office had developed a system to disaggregate assessment data and to graph student progress toward proficiency by grade and by teacher. Further, they employed a special program provided by the state that allowed them and their teachers to “data drill” in on a particular subset of students or even a particular student to look for trends and student strengths and weaknesses (personal conversation with B. Thorstensen, state Office of Educational Accountability, 1/14/09). For example, one could “drill” to discover how many Hispanic ELL students in 5<sup>th</sup> grade were meeting proficiency on a particular New Mexico standard in mathematics. The district superintendent was a participant in a grant-funded leadership academy that focused on data-driven accountability. In conducting the research, it became clear that policy messages about both data and mathematics reforms were important aspects of how principals made sense of the reforms within their schools, and thus Chapter 5 is devoted to an analysis of findings related to the district policies on mathematics reform and accountability.

A purposive approach was also taken in selecting the schools and the principals for this project. The district mathematics coordinator facilitated introductions to a number of Las Palmas principals. Three elementary principals were chosen for reasons related to their tenure, their school demographics, and their willingness to participate in the study. Two of the principals were relatively new to the principalship, and one was a veteran principal. All three schools served over 60% Hispanic students, which supported the research aim of

leadership in predominantly Hispanic-serving schools. Two of the schools served large Mexican immigrant communities, which meant many of their students were English language learners (ELL). In both of those schools, 100% of the students qualified for Free and Reduced Lunch (FRL), which designated them as “high poverty communities” (U.S. Census, 2000). The three principals had varied backgrounds in both leadership experience and teaching experience, which supported the goal of understanding varied perspectives on the leadership role. Figure 4.1 displays demographics and Standards Based Assessment (SBA) scores for each of the three schools.

	<b>Tomasita Elementary School</b>	<b>Camino Real Elementary School</b>	<b>Sands Elementary School</b>
<b>Principal/years at site</b>	<b>Mr. Torres</b> – 2nd year (Was Mid School AP)	<b>Ms. Passos</b> – 2nd year (previously AP Tomasita)	<b>Ms. Rojas</b> – 8th year (18 years as principal)
<b>Grades</b>	Pre-K – 6th (was Pre-K – 4th until 2007)	K-6	K-6th (was 5th-6th until 2007)
<b># Students</b>	509	658	480
<b>% Hispanic</b>	84%	66%	82%
<b>% ELL</b>	50%	1%	60%
<b>% FRL</b>	100%	65%	100%
<b>AYP status 2009</b>	Did not make AYP in mathematics	Have made AYP each year (Only made by lower confidence interval in 2009)	Restructuring 2 (Have not made AYP 4 years) Made AYP in math 2009
<b>SBA math scores</b>	All students: 38% proficient Hispanic students: 35% proficient ELL students – 37%	All students: 45% proficient Hispanic students: 42 % proficient ELL: 14% proficient	All students: 43% proficient Hispanic students: 42% proficient ELL students – 34%
<b>Bilingual math teachers</b>	One at each grade level, some math taught in Spanish, some in English	One at each grade – teaches in English with ESL support	One at each grade level, teach in Eng. with some Spanish support

**Figure 4.1 Demographics and Standards Based Assessment (SBA) scores for Tomasita, Camino Real and Sands Elementary.**

Mr. Torres, at Tomasita Elementary, had been a 5<sup>th</sup> and 6<sup>th</sup> grade classroom teacher for seven years. He taught predominantly in bilingual schools, where most of his students were Hispanic ELLs. Although not fluent, he said he spoke some Spanish, having grown up near his Spanish-speaking grandparents. He enjoyed teaching mathematics and described himself as one to test out the reform materials in his classroom. He was the assistant principal at the feeder middle school before moving to Tomasita as principal, so he understood the challenges at the middle school. Tomasita was 96% FRL and 50% of the students were considered ELL. Although Tomasita did not make AYP during the two years of this study, Mr. Torres noted with pride that the students had made more than the expected progress in mathematics on the 2007-2008 New Mexico Standards Based Assessment (SBA).

Ms. Passos was in her second year as principal at Camino Real Elementary when the study began. She had been an assistant principal at Tomasita, and before that, a kindergarten teacher. She always enjoyed mathematics, and felt “fairly comfortable” with underpinnings of reform mathematics, including the curriculum. She was Hispanic, herself, but she admitted that she spoke only conversational Spanish she had learned from her grandmother. Although the student body was 60% Hispanic, only a handful of students were considered ELL, in fact, not enough to be considered a “sub-group” for AYP determination. The school made AYP each year; however, their ELL students did poorly in mathematics and reading.

Ms. Rojas had been a principal for eighteen years. She opened Sands Elementary in 2000 as an intermediate 5<sup>th</sup>-6<sup>th</sup> school. Sands became a K-6 school when this study began; thus the principal’s leadership role had changed to include supervision of the earlier grades. Eighty-five percent of the students were Hispanic, 95% qualified for free or reduced lunch (FRL), and 60% were considered ELL. Sands had not made AYP for five years, and at the

time of this study was in State Restructuring, meaning the school had strict requirements for improvement, as well as requirements for research-based interventions for struggling students. Prior to becoming a principal, Ms. Rojas's teaching experience was in pre-school and Special Education. She described herself as "one of those kids who didn't get math." Although an Anglo with no Spanish skills, she had attempted to place a bilingual teacher at every grade level.

### **Conceptual Lens**

It is important to be explicit about the conceptual lens of a research project, as each researcher and each project represents "a point of view that legitimizes the manner in which the interpretations are justified or warranted" (Kilbourn, 2006, p. 533). Particular to mathematics education research, there has been a call in recent years to pursue both constructivist and postmodern research paradigms (Ernest, 1999; Lerman, 2004). The conceptual framework of this study embraces both a constructivist and a postmodern lens through which to view the research. The constructivist lens reflects the emergence into the mathematics education research community of theories that see meaning, thinking and reasoning as products of social activity (Boaler, 2004; Ernest, 1992; Lerman, 2004). As a researcher embracing a constructivist paradigm, I believe knowledge is socially constructed and that learning mathematics is "effected by an apprenticeship into the practices of classroom mathematics that carry cultural capital" (Lerman, 2000, p. 26). Although much of the constructivist research in mathematics education has been specific to epistemologies of teaching and learning, this research extends the lens to mathematics education leadership, with the idea that to understand what is happening across mathematics classrooms it is important to examine the experiences of the leaders both inside and outside the classroom.

My own experience as a principal leading mathematics reform taught me that the role of leadership is extraordinarily complex, as all aspects of school leadership are interconnected. It is a role that is ever evolving and requires continual learning and reconceptualization.

A post-modern approach to mathematics education research seeks to broaden the view of mathematics education to include “alternative understandings of mathematical education in schools . . . and to break with the deeply entrenched modern systems of reason which our discipline has built” (Valero, 2004, p. 51). He argues that we must know about the sociopolitical context of the studies. By recognizing the complexities of the mathematics, the shifts in teaching and learning, the policy representations, and the social contexts in which all are enacted, researchers can expand their views on what it means to “do math”, to “teach math”, “lead math” and to “do research”. This study is interested in the principal participants’ understandings of mathematics education, and whether they are considering the leadership necessary to break with entrenched teaching behaviors and moving toward alternative understandings. Research suggests that schools can best manage significant reform efforts if they are pre-positioned to do so. This includes clear direction for the reforms, resources and support for developing teachers’ ability to implement the reforms, and organizational infrastructure that aligns with the intentions of the reforms (Leithwood et al., 2004).

## **Methods**

**Data collection.** The chief instruments for data collection were: a) five formal interviews with each of the three school principals during two school years; b) observations of mathematics classrooms with participant principals, and notes from follow-up conversations; c) four focus interviews with the participant principals; d) informal interviews with district personnel; e) a short teacher survey to assess attitudes about implementation of

reform curricula; f) fieldnotes and memos from observations made at mathematics professional development activities for teachers and principals, and as a “knowledgeable other” for each school’s Lesson Study team; and g) the review of relevant documents and physical artifacts. Member checks were done for the write-up of the principal interviews as a way to establish the validity of the written accounts (Lincoln & Guba, 1985).

There was an additional aspect of the research that both contributed data and perhaps influenced the study in subtle ways. During the first year of the study, I offered to facilitate a course for principals called Lenses on Learning: Observing Today’s Mathematics Classroom following the course developed by the Lenses on Learning Project (Grant et al., 2003). This course was designed to help develop “leadership content knowledge” (Stein & Nelson, 2003, p. 424) in reform mathematics, especially related to supervision. Leadership content knowledge (LCK) “stands at the intersection of subject matter knowledge and the practices that define leadership” (Stein & Nelson, p. 424), and includes what leaders know about the teaching and learning of academic subjects, and their work as instructional leaders. I had two research purposes for offering the first module of this course. First, I wanted to offer something to the principals and the district that were providing me the participants and sites for my research. Second, such a course would provide a space to hear principals talking about their mathematical ideas and their supervisory challenges in ways that could inform my research. All three principals attended at least three of the four sessions in the program, along with several other principals from the district. I was able to observe their mathematical conversations and problem-solving strategies, as well as listen to them talk about their experiences and challenges with supervising teachers in mathematics. Below, in the section about researcher role, I discuss how this may have impacted the study.

*Administrator interviews.* Interviews are particularly useful for getting the in-depth story behind a participant's experiences (McNamara, 1999). The study sought to capture principals' voices and understand their leadership ideas during the first two years of a district-wide mathematics reform effort. Interviews with the principals were intended to elicit their conceptions about their experiences and leadership practices related to mathematics, teaching and learning, with attention to the diverse make-up of their schools. Five taped semi-structured interviews were conducted with each participant between September 2007 and June 2009. A "general interview guide approach" (McNamara, 1999, p. 1) was employed to ensure that the same general areas of information were addressed with interviewee; this provided more focus than the conversational approach, but still allowed a degree of freedom and adaptability in getting the information from the interviewee. The interview questions and probes were designed to target principals' supervisory understandings of the intersection of mathematics content and pedagogy, their understandings and expectations related to data-driven decision making for mathematics improvement, and their ideas about improving opportunities for Hispanic students to learn mathematics in their schools. In addition, interviews focused on how they used disaggregated data to inform decisions and supervisory practices.

In order to discern evidence of change in conceptions over the duration of the study, some of the questions were repeated in more than one interview. These repeat questions were related to principals' ideas about the curriculum itself, the types of instruction they were hoping to see in the classroom, and how they planned to support teachers who may have been struggling to implement the reforms. Interview questions also probed for more detailed information on principals' mathematics content knowledge. Questions for the five different

interviews can be found in Appendix A. Interviews were tape-recorded, and a written transcript was created for use in data analysis. The final write-up from a synthesis of the interviews was member-checked with each of the principal participants. None of the documents were modified, as no changes were recommended.

*Classroom observations.* Over the course of the two school years, I accompanied each administrator on at least three visits to mathematics classrooms. These visits provided an opportunity to learn more about what each principal considered about both the form (program, curriculum design, teaching behaviors) and function (essential understandings that are the goal of teaching). In addition, I sought to learn how they conceived of their roles in supervising and holding teachers accountable for implementation of the reform curriculum. These observations were considered “units of practice” (Nelson & Sassi, 2005, p. 180) in which I observed administrators’ exercise of practical judgment. They were an opportunity to experience how their ideas about mathematics teaching and learning played out in actual classroom settings. Prior to and after the observations, informal interviews were conducted with the principal to discuss his/her perceptions of the observations. The district’s K-6 Classroom Walkthrough Observation form was a key focus of the conversations about the classroom visits, as the form included a checklist of “evidence of” such ideas as mathematics group work, number literacy, and use of the reform program. A copy of the K-6 Classroom Walkthrough Observation form can be found in Appendix B. Included in my questions were several that attempted to uncover each principal’s ideas about the presentation of the lesson, the students’ engagement with the mathematics of the lesson, and next steps in their supervisory role with that teacher and with the teachers as a learning community in general.



Informal discussions were held with the principals before and after each observation in an attempt to understand their perceptions of the teaching and learning they observed.

Notes from these discussions were written in a researcher journal, in addition to follow-up memos reflecting my questions, ideas, impressions, and understandings from those observations. Emerson, et al. (1995) suggest that handwritten memos anchor one's thinking and provide a link back to the site. Memos and notes were transcribed into the computer within 48 hours after the observation to recall as many details as possible.

*Focus interviews.* Another interview technique used to learn more about principals' conceptions of leading the reforms was the focus group. Focus group interviewing capitalizes on communication between research participants in order to generate data, and to learn what a range of views might be (Bogdan & Biklen, 2007; Kreuger, 1988). Group participants can stimulate each other "to articulate their views or even to realize what their own views are" (p. 109). Topics for the focus interviews were designed to encourage participants to bring their individual experiences and ideas to bear. Four focus groups were conducted over the course of the study. The groups always consisted of three to four participants, and often included two principals who were not study participants, but were "friends" or cohorts of the participants. All of the principals knew each other well, and seemed comfortable with open discussions. We usually met at a central location, which was the Teacher Resource Center, where district professional development was often held. In two of the sessions, video clips of mathematics teaching/learning episodes were presented to stimulate discussion. Discussions were audio-recorded and transcribed. Focus group interview questions are included in Appendix A.

***Informal interviews with district personnel.*** Understanding district policies and expectations related to the mathematics reform efforts were important for contextualizing principals' conceptions of leadership. There were key district personnel with whom I interacted in the course of this project, including the Director of Curriculum and Instruction, the Director of Data, Research and Accountability, and the District Principal Mentor. Data from my interactions with key leadership in the district was important for two reasons. First, the district perspective on mathematics reform and expectations for school improvement were drivers for the curricular changes in the schools. The district perspective helped to triangulate any interpretations that principals' may have had of the district decisions that impacted their school leadership decisions. Conversations with the Principal Mentor and the Director of Curriculum and Instruction gave their perspective on the impact to date of the current reform efforts. Information from the director of Data and Accountability on assessment data, school improvement indicators, demographics, professional development, and expectations for improvement were also important. Contact with the Director of Curriculum and Instruction throughout the study was necessary for permission to attend some of the principal professional development sessions. All notes from meetings with district personnel were transcribed into a researcher's notebook.

***Teacher survey.*** The survey was used to gain a teacher perspective on the curriculum and the support they receive to implement it. The survey was developed with the aid of the participating principals so that they could include questions to get information from teachers on the mathematics program, as well. One key purpose of the survey was to learn teachers' attitudes. How was the curriculum working with their students and how did it match with how they believed mathematics ought to be taught? The survey also sought to learn: whether

teachers were using the reform program “with integrity”, or as the program was designed; who they talked to about mathematics teaching and learning; and how often the principal observed a mathematics lesson. The survey was ten questions, delivered and taken on a web-based tool (Survey Monkey, 2006), which was accessible from each teacher’s classroom computer through their school e-mail. The principals’ participation in the design of the survey ensured that they, too, had a chance to formulate questions, which in turn reflected something of their thinking. Principals agreed to send the survey through their school e-mail to all teaching staff. The survey was anonymous, but compiled survey information was shared with principals in order to elicit more about their conceptions. A copy of the survey can be found in Appendix C.

*Fieldnotes and memos.* Fieldnotes are “a written account of what the researcher hears, sees, experiences, and thinks” (Bogdan & Bilken, 2007, p. 119) while in the field collecting data and while reflecting on the data in a qualitative study. Fieldnotes were kept in a notebook, written during or within 24 hours of the field experience. Some researcher memos were written following taped interviews with the principals in order to capture more subtle meanings, impressions, and “extra remarks said before and after the interview” (ibid, p. 119). Memos were also written to document my observations about the site, capturing thoughts and ideas about the sense of community, the interactions in the main office and the parking lot, and what was displayed on the walls.

Other memos were written to capture observations and ideas developed when I attended professional development activities. In order to understand the scope and quality of teacher professional development related to mathematics, I attended or participated in two types of activities. First, I attended the introductory training that teachers received for one of

the district adopted curricula, Connected Mathematics 2 (CMP2). This allowed me to understand how the district prepared teachers and what sort of questions teachers had. It also allowed me to observe principals if they attended and participated. Continuing in that vein, I also attended two of the monthly grade-level collaborations for teachers in order to understand the scope of the mathematics professional development that was offered.

The second type of professional development that was documented in researcher memos was my participation as a “knowledgeable other” in the mathematics Lesson Study teams at each of the three schools in this study. In mathematics Lesson Study, the knowledgeable other is an outside expert who collaborates with the team “to enhance content knowledge, guide thinking about student learning and support the team’s work” (Yoshida, 2005, p. 4). As a knowledgeable other, I was able to listen to teachers’ thinking about mathematics lessons and mathematical ideas. I was also able to observe the principals if they attended the delivery of the lesson or the follow-up discussion. One of the lessons was used for discussion of teacher understanding in a focus interview.

***Document review/physical artifacts.*** Documents pertaining to the district’s mathematics reform initiative were used to inform this study. These documents include the district website, a mathematics “pacing guide” developed by the district mathematics coordinator, the Classroom Walk-through Checklist, and the Balanced Math framework. A key document specific to each school was their Educational Plan for Student Success (EPSS) in which they outlined areas in need of improvement, based on student performance on short-cycle assessments. Principals must specify strategies for increasing the number of students who are proficient in reading and mathematics. The mathematics goals and strategies outlined in each school’s EPSS was reviewed and discussed with the principal.

## Data Analysis

The goal in data collection was to gather a substantial amount of rich, thick descriptive data (Creswell) over a period of time, through the words of the participants. Data analysis was an on-going process both in and out of the field as I continually worked to make sense of what I was seeing and hearing. Data analysis actually began prior to formal collection of the data, as Creswell (2007) suggests, with the selection of the site, the participants, and the interview questions. Then, throughout the course of the study, I transcribed the interviews and researcher notes. The transcribing of experience is an important analytical experience. It is through transcription that the researcher begins the interpretation of the lived experiences (Creswell, 2007). Within this study, interviews were audio-recorded and transcribed. The transcriptions included pauses and emphases that triggered my memory of the interview to recall *how* a story was told, not just the words that were used. My task was to form a thick description from the data, as well as to relate the description to the themes in the literature (Wolcott, 2001). Because this was a cross-case synthesis, with the goal of achieving an in-depth understanding of principals' conceptions, it was necessary to do a synchronistic analysis – simultaneously considering each principal case as unique, analyzing each case, while also considering themes across the cases, as well as assertions and generalizations from the literature and the theoretical lens (Creswell, 2007).

All interview transcriptions, video data, researcher notes, and observation notes, in addition to the statistical and demographic data on the sites were organized and reviewed for general themes and to establish patterns. A process of open coding supported the work of discovering themes. Since “coding is a progressive process of sorting and defining” (Glesne, 2006, p. 152), scraps of collected data were “clumped” to create an organizational

framework. This framework was then used to look for similarities and differences within each of the cases. Coded passages were put into an Excel spreadsheet and labeled with all appropriate codes, often multiple codes. Those code words allowed me to sort and re-sort data to highlight themes, and to form a picture or story for each principal. The three organizational frameworks used to analyze themes cross-categorically were the LCK construct, the PRIME leadership principles, and the three aspects of sense-making theory. Sample matrices are included in Appendix D. In this way, I was able to consider the complex beliefs, understandings, knowledge and ideas that comprised each principal's leadership role. This allowed for identification of themes within each individual case. Thus my analysis chapter of individual cases stands alone (Chapter 6). Coded data from interviews was triangulated with data from focus group interviews, observation data, and district data on Standards Based Assessment scores and school demographics to provide the most complete picture possible of principals' conceptions of their roles in mathematics reform implementation.

A second thematic analysis was used to identify themes *across* cases. The organizational framework for identifying the emergent themes across cases was to look for similarities and differences in principals' conceptions related to the sense-making theory. I analyzed principals' stories to discover how sense-making about district policies influenced and was influenced by LCK and school context across cases. The findings are discussed in Chapter 7.

### **Researcher Role**

An important issue to consider in qualitative analysis is the role of the researcher. A qualitative researcher can have a significant impact on the research, both as designer and in

perspective. I approached the research wearing two hats – that of a researcher, and that of a recently practicing school principal. It was necessary, in my role as a researcher, to address issues of perspective and trustworthiness (Creswell, 2007). My credibility as a researcher has been contingent upon the participants’ acceptance of me as a partial insider with sufficient experiential knowledge to understand the system and the mathematics. Each of the participants was aware of my own professional background as a principal in a school with demographics similar to theirs, where we had adopted a reform mathematics curriculum. This seemed to create a sense of collaboration, which is reflected in many of the interviews. They also knew of my interest in mathematics teaching and learning, which was highlighted in the Lenses on Learning course. While my role was to facilitate, the fact that I prepared the sessions and delivered the agenda and materials likely portrayed me as “expert”, even though I feel that I am a learner, as well. I had to beware my dual identity as mathematics education researcher and principal in order not to foreground my own perspective. Several aspects to the research design helped me to do that. First, I was often in the role of “learner” in the interviews. Questions were designed to encourage principals to talk about their conceptions from a lens of strength, not fear. Second, I participated with them as a learner in both teacher professional development and principal development. Third, principals were given the opportunity to review my analysis of their conceptions.

### **Limitations**

This research is limited by the fact that it represents only a small sample of principals, and therefore is not generalizable. However, it will provide insights into what principals value and pay attention to in their leadership roles related to mathematics. Thick descriptions of the findings are a way of beginning to understand the conceptions that guide their practice.

The act of participating in the research may be an influence on how principals perceive their roles over time. My presence as a researcher, asking questions about mathematics teaching and learning in order to prompt reflection, may cause the principals to pay more attention to their leadership role in mathematics, thus impacting their practice and their ideas. For example, one interview experience showed that posing a question about English Language Learners in the mathematics classroom was the first time two of the principals had really confronted the idea. Their lack of response was data, but it triggered thoughtfulness that may have spurred new thinking. If the goal of the study is to learn about principals' conceptions, any new awareness or conceptual change was important data to note.

Finally, this research was limited by the fact that the data reflected "snippets" of information, during isolated windows of time. A principal's day-to-day decision-making and leadership behavior is the true indicator of his or her deeply held conceptions of the leadership role. This study and the analysis of the findings was an attempt to capture and interpret the isolated data and put each "snippet" into the larger emerging themes to form a picture of what it is that principals find challenging and what they see as the possibilities in this complex role. As districts and states are raising the bar on student achievement, principals are expected to manage complex change. Reform mathematics is a part of that complex change. How they conceive of their role in leading mathematics reform can help inform districts about the kinds of supports principals may need to become most effective in improving mathematics achievement for *all* students.

In spite of the limitations, I believe that both my own experience and my methodology will provide qualitative integrity for this research. The voices of the principals will provide important insight into what is important to consider as districts continue to press



school leaders for greater accountability for improving student achievement in their schools.

It is my intention to use impeccable qualitative methods to provide rich data to inform the educational community about what is both possible and challenging for principals as they attempt to support best practices in the teaching and learning of mathematics for all students.

## Chapter 5: District Findings

Districts play a pivotal role in mathematics reform efforts. They have the capacity to “mobilize limited resources, give legitimacy to a reform effort and [promote] the crucial interplay between central office and school sites that can spell the difference between implementation success and failure” (Cuban, 1990, p. 4). District leadership of mathematics reform is the layer of leadership content knowledge “where district-wide issues are being dealt with” (Stein & Nelson, 2003, p. 8). District and state policies and resources become the press, guidance and support that principals have to broker in their understanding of how to lead the reform mathematics implementation within their individual schools. The district’s story provides important policy and social context for understanding how principals made sense of their leadership role in implementing the reforms.

I begin this chapter with the story of the Las Palmas (all names are pseudonyms) district as it relates to the reform initiatives and the adoption of the reform mathematics curricula. While, as Elmore (1997) noted, districts are often relegated to “context”, the significance of the district’s story became increasingly evident as I sought to understand principals’ sense-making related to reform policies. The district story is then analyzed according four policies that broadly related to mathematics reform: accountability policies; specific mathematics reform initiatives; supervision policies; and policies pertaining to opportunity to learn.

### **The District Story**

As explained in the previous chapter, the site selection for this research was very purposive, with two overarching criteria. The first criterion was to find a district that had recently chosen to adopt an NSF research funded, standards-based reform mathematics

program. This provided an opportunity to explore principals' interpretations of mathematics policy messages. The second criterion was that the district had schools serving more than 50% Hispanic students. This addressed the larger goal of contextualizing this research in predominantly Hispanic-serving schools as well as provided a way to consider the equity principle (NCTM, 2000). A district with both a policy to adopt a standards-based reform curriculum and a large Hispanic population allowed me to expand on the original construct of Leadership Content Knowledge to include equity and curriculum.

The district of Las Palmas met both criteria for selection, with some added aspects that enriched the findings: a superintendent who had been deeply involved in a leadership training program that emphasizes data-driven decision-making, schools that had over 80% Hispanic students, many of whom were ELL, a distinctive community history, and a district mathematics coordinator. In 2007, when this research began, only 5 of the 15 schools in the district met AYP in mathematics. The district as a whole had not made AYP in mathematics at any grade band during the two years of this project.

Diverse is an appropriate word to describe Las Palmas. It is diverse in its culture, diverse in its economy, architecture, scenery, professions, recreations, history, and probably its future. At the time of this study, Las Palmas village was still something of a small town, with a population of around 11,000 (U.S. Census, 2000). However, the school district was geographically very large, spreading out alongside the Rio Grande River valley and up into the neighboring mesas, to include parts of the surrounding counties. Bounded on the north by an Indian Pueblo and the south by another small town, growth was spreading east and west in disparate pockets. A mixture of farming and ranching fought to maintain a strong hold against inevitable urbanization. Many families have lived and farmed here for generations,

most of them Hispanic Land Grant families. Land grants were made to individuals and communities during the Spanish (1598-1821) and Mexican (1821-1846) periods of New Mexico's history.

Several more isolated communities were forming out on the mesas, across the river to the east of town. Homes had cropped up either as planned developments or because groups of families with trailers had located a trailer there. All of these communities had names (Pastural, La Loma, El Rio) and reputations (“high poverty”, “high drug activity”, “the nicer place to live out there” and “the other side of the river”). Some were sprawling mobile home communities where the median age is twenty-seven, and the median home value is \$82,516 (city-data.com). The median family size in these communities was larger than in the state, and the median income was lower, as was the number of adults who have attended at least some college. The median age of these “east-side” communities was significantly below the state average, as were the employment rate and the length of stay since moving. The percent of foreign born and percent of Hispanic families was “significantly above” the state average (U.S. Census, 2000). The majority of households had at least two school-age children. I drove through the La Loma community with one of the principals in this study (Ms. Rojas), and learned that the streets, most of which are dirt, were not marked, and there were no house numbers. There were a number of burned out trailers “because either it was a meth lab, or they rig up a wood stove for heat and it torched the home”, as the principal reported. Chickens ran in the yards, and a few homes hosted a cow or a horse. Two of the schools in this study served these communities.

## **District Policies Related to Mathematics Reform**

The Las Palmas district began the mathematics reform initiatives on the heels of a several-year intensive literacy reform. Every elementary school had an academic coach trained in literacy. Principals and teachers had focused professional development efforts on the teaching and learning of literacy. In order to unify the district in its efforts to improve the teaching and learning of mathematics, the district had to refocus. They implemented reform policies in four areas: accountability and data; curriculum reform initiatives; supervision of instruction; and increasing opportunities for all students to become proficient in mathematics. The following paragraphs describe the district policy representations in each of these areas.

**Accountability and data policies.** There were several district-level expectations/policy representations that opened the possibility for brokering and interpretation. The district was very serious about improving student proficiency in mathematics. Their mission was “every student, every year, at or above grade level.” The district focus on data-driven decision-making meant that principals were required to keep detailed records of both standards-based assessment data and “short cycle” assessments, which were given three times during the year to assess student progress toward proficiency goals. The superintendent and the district data office expected principals to monitor data by school, by grade and by classroom. Principals had access to a large district data-base called the Data Warehouse that allowed them to disaggregate and to graph data by grade, by teacher, and by student. Further, they had a special program provided by the state that allows them and their teachers to “data drill” in on a particular subset of students or even a particular student to look for trends and student strengths and weaknesses (personal conversation with Beata Thorstensen, Office of Educational Accountability, January 14, 2009). For example,

there was a way to discover how many Hispanic ELL students in 5<sup>th</sup> grade were meeting proficiency on a particular New Mexico standard in mathematics. Principals in Las Palmas were all trained in the use of this data-base and encouraged to use it with their teachers (personal conversation with B. Thorstensen, January, 2009).

Principals were also required to prepare a “data rich” state-of-the-school presentation to the school board each spring. The district data and accountability office gave them templates for recording assessment data, with a particular focus on the short-cycle assessment, Measure of Academic Progress (MAP), which was administered three times a year, fall, winter, and spring. Board members were known to study the data prior to the public presentation by the principal, and to make comments and recommendations about individual teacher performance (Principal Torres, 1/22/09).

**Curriculum policy and reform initiatives.** In an attempt to address the fact that less than 38% of their students were proficient in mathematics in 2006, according to the state Standards Based Assessment data (state Public Education Department, 2009), the district adopted Ramp-Up, an intervention program “to meet the needs of students who were not proficient in the middle school” (2007 district curriculum website). A mathematics coordinator was hired to ensure that the intervention program, Ramp-Up, was implemented and supported in each of the middle schools. In addition, the coordinator was given the charge to organize a group of teacher representatives from each school to select a research supported standards-based mathematics curriculum for the 2007-2008 school year. The adoption of a district “mandated” curriculum gave an important research consistency parameter to the study. There would be no mixed-messages about *what* curriculum to use,

although within each school community, the way it was implemented would vary. Thus the brokering role of the principal was highlighted.

In the summer before implementation, 2007, the district mathematics coordinator organized a week of training in the new math curricula for all teachers. Principals were invited to attend, although only one of the principals in this study attended, and that was sporadic. The training was offered by the textbook companies and was an introduction to the curriculum and the intended pedagogy. The curriculum adopted for kindergarten through fifth grade was *Investigations in Data, Number and Space* (TERC, 2008). The curriculum for sixth through eighth grades was *Connected Mathematics 2* (Lappan et al., 2007). This meant the three principals in this study, whose schools served kindergarten through sixth grade, had two curricula to supervise.

The first year of implementation, the District Mathematics Coordinator did a number of things to guide schools toward implementation of the reforms. After the initial teacher training, which was a three-day training provided by the publishers, she organized the academic coaches from each school to provide the ongoing professional development for mathematics. Each school had an academic coach, who was originally hired as a literacy coach. “They were hired for their literacy skills, and most are not strong in the area of math teaching” (Principal Torres, 11/11/07). Teachers met on a monthly basis by grade level across the district, with one of the coaches facilitating the professional development. Principals were also invited to attend these professional development sessions. The mathematics coordinator stated that none of the principals came to more than the initial training, and then it was only for part of the training.

Component	Balanced Math		Time	Organization
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During the first year of implementation, the mathematic coordinator also developed documents that served to communicate implementation policy. One such document was a Balanced Math Schedule, which outlined a series of lesson components that added up to a 70 - 75 minute math block, plus an additional 10 minutes for calendar math. All principals received this schedule during an administrative meeting, and were e-mailed a copy as well (see figure 5.1). The information on the schedule carries a very significant policy message for principals, in that it conflicts with the policy message delivered in the reform curricula themselves. Both the Investigations and CMP2 curricula call for a minimum of sixty minutes for the lesson, with an additional fifteen to thirty for fluency skills, homework review and daily practice. The Balanced Math schedule allots only forty minutes for the reform mathematics curriculum lesson, which is a contradiction of the intended curriculum. In addition, there is no mention of the components of the Investigations and CMP2 lessons that include math fluency practice and number literacy.



Calendar Math	Conceptual	Money Calendar Place Value	10 minutes Keep separate from Math block if possible	<ul style="list-style-type: none"> <li>• Whole class, student or teacher led</li> </ul>
Daily Review	Conceptual Problem- solving	1-5 questions Review of concepts Include at least 1 problem solving a day	5 minutes Time for “teaching Points”	<ul style="list-style-type: none"> <li>• Whole class, students work independently Teacher grades while students work</li> <li>• Address “teaching points” (errors) with students individually.</li> </ul>
Timed Test	Computational Fluency	Leveled Timed	5 minutes	<ul style="list-style-type: none"> <li>• Whole class, students work independently</li> </ul>
Number Literacy	Conceptual Computational Fluency Problem Solving	Dots and Grids What’s My Place? What’s My Value	20 minutes	<ul style="list-style-type: none"> <li>• Mostly whole class, teacher led</li> <li>• Possible small group follow-up</li> </ul>
Standards- based lesson	Conceptual Computational Fluency Problem- solving	Investigations or CMP Constructivist strategies: allow students to experience math (manipulatives) in order to construct their own knowledge, while teacher artfully uses guiding questions to facilitate their learning	40 minutes	<ul style="list-style-type: none"> <li>• Collaborative groups, pairs, whole class</li> <li>• Have collaborative groups for part of the lesson at least 3 days a week</li> <li>• This is time that dynamic Guided Math groups can take place led by teacher</li> </ul>
Math Journal	Conceptual Problem- solving	Related to standards-based lesson or Number Literacy	5-10 minutes	<ul style="list-style-type: none"> <li>• Students work independently or in pairs</li> <li>• Teacher can grade while students look over shoulder</li> </ul>

**Figure 5.1** *Balanced Math Schedule*

It is important to note that the policy representations about curriculum were complex. In addition to the reform curriculum adopted, schools were expected to continue with the special intervention mathematics program for struggling students. Short cycle assessment scores were used to place struggling students in the Ramp Up program for 6<sup>th</sup> grade. These interventions meant school leaders had to make decisions about how to serve struggling students. Would they get the full reform mathematics program, with an additional hour for the intervention, or would the students receive only the intervention, thus missing out on the reform opportunities?

In addition, during that first year of implementation, the Mathematics Coordinator provided resources and training for teachers in two number literacy programs which would essentially supplement the adopted curriculum and “support students’ development of base ten number concepts” (district mathematics coordinator, 1/20/08). As will be shown in the individual principal stories, this attention to multiple strategies drew attention away from the reform curriculum and complicated their sense-making about how to lead.

In the spring of 2008, the superintendent asked at a district principals’ meeting what percent of teachers were using the new standards-based curriculum. According to two of the principals in this study, Principal Torres and Principal Passos, the response from most principals was 60% (focus interview, 2/9/09). It is important to note that 60% may have been a high estimate because, as the case study data will show, principals considered partial implementation in their count, which does not meet fidelity concerns.

At the end of the 2007-2008 school year, the math coordinator resigned to take a job in another district. The Las Palmas district did not seek to fill the open position, due lack of funds. Therefore, during the 2008-2009 school year, principals were responsible for

providing mathematics professional development at their own sites. There was money left from an instructional improvement grant to pay for principals and their academic coaches to attend a Connected Mathematics conference during the spring of 2009. Two of the study participants went. One took a team from his school, using funds from Title I. Other than that, there was no district-wide professional development activity related to mathematics. The district focus turned to a year-long series of trainings on classroom management and to mentoring support for struggling teachers.

**District policy related to supervisory practices.** A district policy that related to principals' supervisory roles in mathematics reform was a policy that was negotiated several years ago with the district's teachers' union. There are explicit guidelines stipulating that a principal cannot observe in a teacher's classroom for more than fourteen minutes without calling it a formal observation, which requires forty-eight hours advanced notice. In addition, a principal should not do a disproportionate amount of observations on one teacher over the others. (personal conversation with Las Palmas National Education Association representative, August 2008). This policy carries both explicit and implicit representations that impact the social context in which principals function at their schools, as will be seen in the findings. This policy may have been one of the levers that drove the superintendent, at the beginning of the 2008-2009 school year, to ask all principals to perform and document classroom walk-throughs in 90% of classrooms every week (Mr. Torres, interview 12/3/08).

Principals were expected to "walk through" classrooms to observe teaching of literacy and mathematics instruction, with the explicit intent of "attending to best practices in teaching" and holding teachers accountable for implementation of the curriculum with full student engagement. Principals were required to send data on their walk-throughs to the

district office every Friday. The district devised a form to be used to record observations during the walk-throughs. The section for mathematics observations highlights the adopted mathematics curriculum, the supplemental programs, and student engagement. A look at the walk-through form (Figure 5.2) reveals that it guides principals to address what researchers have termed “superficial features of reform” (Ball, 2004; Spillane, 2002). In mathematics, the form guides principals to look for the following: use of manipulatives; word walls; math vocabulary; number literacy; concept building; students writing about their thinking; Investigations (the curriculum for grades K-5); CMP2 (the curriculum for grades 6-8); and student application. These “look fors” serve as a form of policy representation - policy that was presented at a monthly instructional leadership meeting with the director of Curriculum during the second year of the reform implementation. As will be shown in the principal participant findings, there were mixed ideas about the usefulness of this practice/policy for reasons related to social context, principal-teacher relationships, and “press”.

<b>Las Palmas Schools</b>					
<b>K-6 Classroom Observation Checklist</b>					
<u>Balanced Math</u>					
<ul style="list-style-type: none"> <li>• <b>Evidence of:</b> <ul style="list-style-type: none"> <li>○ Use of manipulatives</li> <li>○ Word walls (interactive)</li> <li>○ Math vocabulary</li> <li>○ Number literacy Approx.</li> <li>○ Concept building</li> <li>○ Students writing about their thinking</li> <li>○ Investigations</li> <li>○ CMP</li> <li>○ Student application</li> </ul> </li> </ul>	<p><b>Observed:</b></p> <p>% student engagement:</p> <table style="margin-left: 40px;"> <tr> <td>0</td> <td>25</td> <td>50</td> <td>100</td> </tr> </table> <p>Evidence that students are:</p> <ul style="list-style-type: none"> <li>*Thinking</li> <li>*Listening</li> <li>*Actively participating</li> </ul>	0	25	50	100
0	25	50	100		

**Figure 5.2 Portion of District Walk-through checklist related to mathematics**

**District policy and opportunity to learn.** The Las Palmas school district served approximately 8,500 students, sixty-three percent of whom are Hispanic. Two of the schools in this study had more than 80% Hispanic students, many of whom were ELL. For the 2007-2008 school year, the district employed a Bilingual Coordinator, and she made it possible for several of the principals in the district to visit a district in San Diego that is a model for serving bilingual students. She also arranged for several of the teachers at each of the schools in this study to receive Guided Language Acquisition Design (GLAD) training, which was professional development in the area of language acquisition and literacy. The strategies and model were designed to promote English language acquisition, academic achievement, and cross-cultural skills (see Project G.L.A.D. website at: <http://www.projectglad.com/>). However, the training had been focused on literacy, and there was no follow-up in the schools after the one year.

### **Summary**

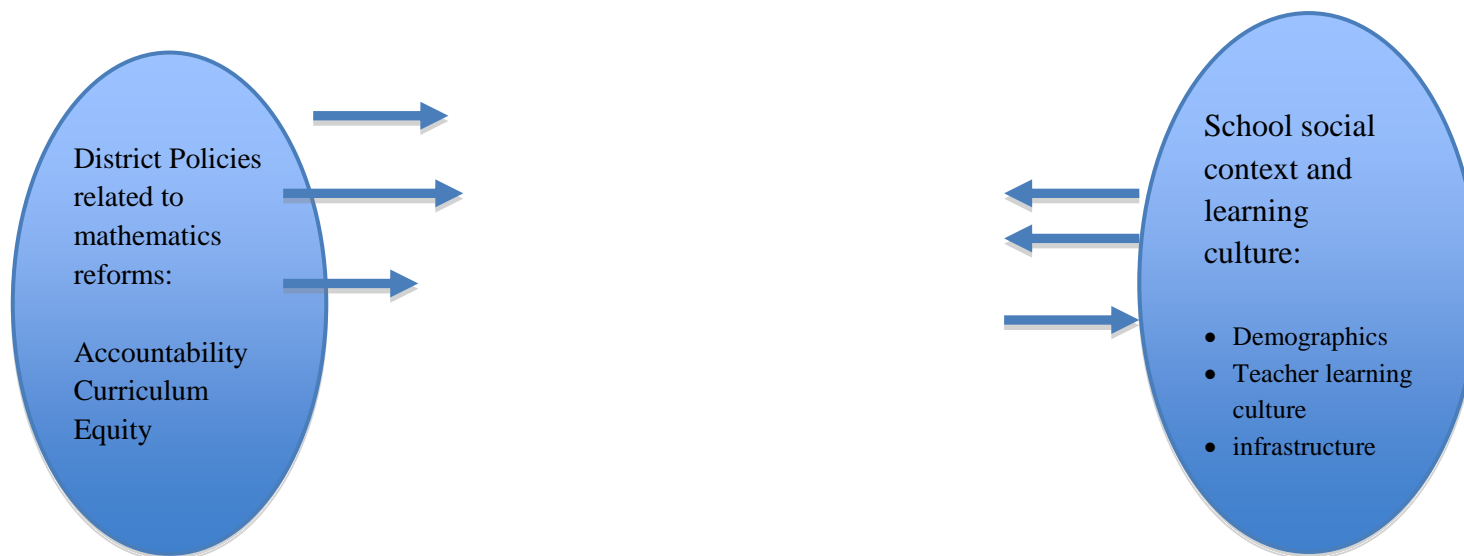
These were the district policy representations that principals had to interpret in their role as brokers of reform. As “street-level bureaucrats,” they mediated district policy messages through their own beliefs and understandings, as well as through their ideas about navigating the school context. Principals were responsible for making political choices when fundamental values conflicted. The next chapter presents the individual stories of each of the three principals, including their sense-making about the district policies presented in this chapter.

## Chapter 6: The Cases

### Introduction

This research investigated three principals' conceptions of their leadership roles in the implementation of mathematics reform in their schools. Over a period of two school years, from fall 2007 to spring 2009, each participant and I explored her/his ideas and beliefs about leading the reforms in her/his school, including what it means to teach and learn mathematics within the demands of a new curriculum, the struggles of changing instructional practices in the context of their individual schools, and the challenges of making sense the reforms in light of district policy mandates and expectations. The analysis presented in this chapter seeks to keep each participant's story distinct, as an individual case. Chapter 7 will present a cross-case analysis of common themes.

This chapter attempts to answer the main research question for each principal participant: how does she/he conceive of a leadership role in the implementation of the district mathematics reform initiatives in predominantly Hispanic-serving schools? The theoretical constructs of LCK and sense-making that framed this study helped in the analysis of data codes and themes across cases. Codes and themes from the individual case data revealed categories that aligned with LCK, district policy representations, and school context. Figure 6.1, below, was developed as a synthesis of the constructs that framed the study. The figure suggests that sense-making about the leadership role in mathematics reform is a complex interaction of conceptions about the teaching and learning of mathematics, the unique context of the schools, and the interpretation of district policies related to the reforms. Understanding principals' conceptions of leading mathematics reforms required an integrated analytical model, not a linear model. Combining the constructs of LCK and sense-making.



**Figure 6.1** A Dynamic Analytical Model of LCK and Sense-making used in cross-case analysis.

However, a discussion of the findings requires a more linear presentation. Each principal's story is analyzed according to the four research sub-questions, in the following order:

- How does the unique social context of the school community (organizational design, school culture, traditions) influence principals' ideas about leading mathematics reforms? This discussion includes the demographics of each school because they are important in analyzing and discussing the principals' sense-making and socio-construction of meaning about their role.
- What are principals' conceptions of the substance of the reforms? What beliefs, ideas, knowledge, experiences, understandings related to mathematics and the NCSM PRIME leadership principles of mathematics (equity, teaching and learning, curriculum, and assessment) do principals bring to their leadership role? I begin this section with an account of each principal's background, recognizing the importance of what Bibby (1999) called "mathematical histories", as influential in her conceptions about leadership and about mathematics, teaching and learning. Then I discuss their *beliefs and philosophies* of mathematics. Finally, I present an analysis of findings on their LCK related to the PRIME leadership principles: teaching and learning; curriculum; assessment; and equity.
- How do principals make sense of the district and state policies related to the reforms (accountability, curriculum, equity)? I consider how they interpret and mediate the district policy representations, given their conceptions of the reforms and their school context.



- What do principals believe about leading the community of adult learners? I analyze findings on each principal's beliefs about teachers as adult learners, including their conceptions about both supporting teachers in developing new pedagogical and curricular skills, and holding them accountable for implementing new learning.

This chapter is organized according to the research sub-questions, and thus the four major themes that organize their stories. I begin with the school context in which principals come to make sense of their ideas about the reforms. They both influence and are influenced by the culture and infrastructure of their schools. Then, I look closely at their leadership content knowledge and their beliefs and ideas about the PRIME Leadership Principles related to teaching and learning. Next, I address the theme of how principals make sense of policy representations related to mathematics reform. Finally, I consider how all of these conceptions come together in their ideas and beliefs about leading a community of adult learners in improving mathematics teaching and learning for all students, and particularly Hispanic students who have traditionally struggled to meet proficiency.

The final summary for each principal's story integrates the ideas from each of the themes. This is an attempt to tie each sub-question back to the theoretical construct, and to look at how principals are making sense of leading improvement in mathematics teaching and learning. I consider how each principal conceives of his/her role in the three critical aspects of leadership emphasized in the leadership research (Leithwood, et al., 2004): setting the direction for mathematics teaching and learning, developing the people to be able to do the job, and redesigning the organization to facilitate the reforms. Figure 6.2, below, outlines the organization of this chapter.

Organization of Principal Stories

- I. School context
- II. Leadership content knowledge (LCK) for mathematics, teaching and learning
  - a. Principal's mathematical history
  - b. Beliefs/philosophy about mathematics
  - c. Beliefs, understandings, experience, knowledge, ideas about the PRIME leadership principles
    - i. Teaching and learning
    - ii. Curriculum
    - iii. Assessment and data
    - iv. Equity
  - d. Conceptions of leading adult learners
- III. Sense-making and district policy representations
  - a. Accountability and assessment policy representations
  - b. Curriculum representations
  - c. Supervision
  - d. Equity
- IV. Conceptions of the role as Leader of Adult Learners
- V. Summary of role conceptions

**Figure 6.2 Chapter Organization of Principal Case Stories**

The order of presentation of the three individual principal case stories is not intentionally important. Mr. Torres' story is presented first because I had most recently transcribed and reviewed his data. Ms. Rojas is last because I struggled the most to tell her story, since there was so much evidence of commitment and so little evidence of LCK for mathematics. Thus, it took me longer to formulate her story. Each principal had a unique story to tell related to implementation of the district's mathematics reform initiatives and how they conceived of leading those reforms in their schools.

**Mr. Torres, “The Data Guy”**

**School context.** Tomasita felt like a community school. Each time I visited, I noticed new flyers, in both English and Spanish, announcing a science night, a spelling bee or a community event. The custodial staff joked easily with teachers and students in the hallway, the office staff was bilingual, and they were extraordinarily courteous and efficient. The security guard was never sitting at a front desk; rather he was moving around the school, interacting with students and staff. All in all, it was a very friendly welcoming place.

While the feeling inside Tomasita Elementary School was warm and welcoming, geographically speaking, it was not a neighborhood school. Every student arrived by bus. Advertised only by a small green road sign the size of a notebook page, Tomasita was a bit challenging for a visitor to find without a good map. Located outside the city limits, about a fifteen minute drive from the center of Las Palmas, the school stood in the chamisa and tumbleweeds of the southwest mesas. There were five schools out in this remote section of the district - three elementaries, a middle and a high school - and principals and teachers all referred to themselves as being “the schools on this side of the river,” which connoted greater challenges due to poverty and being physically and socially removed from the central operations of the district.

Although standards-based assessment scores used by the state accountability system indicated that Tomasita students were not progressing in mathematics enough to meet state expectancy ratings, the scores belied the progress that was being made toward greater proficiency. The second year of this study, SBA scores had jumped from 10% proficient in mathematics to 41% proficient. At the time of this study, there had been fewer Tomasita

students matriculating into Ramp-Up, the middle school intervention program for students below proficiency in mathematics. The school short-cycle assessments also indicated a general improvement trend in the number of students at or near proficiency in mathematics. But by all accounts, the students still had a long way to go. At the time of this study, Tomasita had not made AYP in mathematics for three years (Public Education Department accountability website, 2009). Tomasita served approximately 500 students from pre-Kindergarten to sixth grade. Until 2007, the school was Pre-K through fourth grade, but it ex-panded to include fifth and sixth grades when the district dissolved its intermediate schools. Actual demographic data (census 2000) put their Free and Reduced Lunch (FRL) at 84%, although 100% of the students were considered economically disadvantaged by the state accountability system (NMPED, 2009). About half of the students were English Language Learners (ELL), and most of them lived in a neighborhood described as “the war zone” by locals. There are records of meth labs and drug-related violence (county sheriff department records, 2005-2008), in addition to the poverty in the community, which is both generational and the situational poverty of new immigrants.

In spite of the challenges, the staff was fairly stable. Mr. Torres hired about seven teachers in the two years of this study. Teachers ranged in experience from beginning teachers to several with more than twenty years of experience. For several years, the school has had an infrastructure in place for teacher collaboration and adult learning for several years. Teachers had collaboration or “professional learning community” time built into their schedules every week, alternating between grade level and cross-grade level meetings. They had a literacy coach, as do all Las Palmas elementary schools, and until the year before Mr. Torres came, they had a mathematics coach. That position was cut due to funding concerns.

For the two years of this study, the school had two teams of teachers involved in mathematics Lesson Study, a professional development program supported by the district in which teams of teachers collaborated to plan, implement and critique mathematics lessons.

**Mr. Torres' mathematical history.** Growing up in Utah, Mr. Torres learned quickly that speaking the native Spanish of his grandparents was “not cool.” While he often heard Spanish in the home, and he understood quite a bit, he expressed disappointment that he never really learned to speak or write fluently in Spanish. He did, however, feel connected to his heritage, and appeared very at home in the Tomasita community. He seemed very comfortable with parents, grandparents, students and staff.

He began his career as a recreational therapist in a psychiatric hospital, which he believed helped him with classroom management. “I learned how to deal with behavior issues there, so I never had problems with behavior as a teacher” (Focus Interview, 2/7/08). In fact, he carried that philosophy into his leadership, stating, “There will be no kids sitting in my office. They don't learn at a desk in my office. They learn in the classroom” (Focus Interview, 2/7/08). His focus on learning as the core work of the school included a deep interest in the students, and he knew most of them by name. He used last names as a show of respect and to create a “we're serious about learning” atmosphere. “We expect all students to say please and thank you. It's respect” (Focus Interview, 2/7/09). As I spent time in the halls, classrooms and cafeteria with him, he offered greetings to students that communicated a true relationship, such as, “Hello, Mr. Marquez, did you bring your trumpet today?”

I rarely found Mr. Torres in his office when I went for interviews. The first time I met him, he was in the cafeteria, keeping the lunch line moving, chatting with students, and

calling them by name. It was his first year at the school. The second time I went, his secretary said he was out on the playground killing a rattlesnake that had been spotted by a kindergarten teacher. Sometimes I found him in the hallway with a parent or talking to a grandmother in the office about her volunteer work. By all accounts, it was clear that he was deeply committed to the students and families in this community.

His teaching career consisted of seven years instructing all subjects in the sixth grade. Six of those years were in the Las Palmas school district. He spoke very fondly and confidently of his years as a teacher, and particularly of teaching mathematics. As a child, he remembered growing frustrated because “the teacher always just wanted the right answer, and I wanted to know why” (Interview, 9/12/07). He did well in mathematics in high school and college, but felt he gained much of his mathematics understanding while teaching it. “I liked teaching math. I tell my teachers I was the best out of all of them at my school. They seem to respect that” (Interview, 4/3/09). He described himself as “the teacher who was always willing to pilot new mathematics materials.” Yet he also acknowledged that he has learned a lot from watching his best teachers. “I’ve watched Ms. R. and Ms. T., and I’m actually learning how to teach kids math!” (Interview, 12/3/08). In fact, a CMP2 professional development workshop he attended was motivated by his desire to learn the curriculum because at some point he planned to go back to the classroom. “Eventually I’m going to be a teacher again, so I better use this chance to learn CMP” (Interview, 12/3/08).

Curious about administration, and feeling it would be “good to move a school in the right direction and hire good people,” Mr. Torres got his administrative license. Prior to becoming principal at Tomasita, Mr. Torres spent four years as an assistant principal, most recently at the nearby Middle School, where Tomasita students matriculate. He described

his leadership responsibilities there as mostly supervising instruction and student discipline. He spoke on several occasions about the importance of preparing students for middle school so that they are “able to show that they can do math, because otherwise they will be seen as behavior problems” (Focus Interview, 6/2/09). He seemed concerned that teachers at the middle school were even more challenged by the pedagogy of reform. “Teachers don’t want to have kids for two periods. They are used to 55 minutes. They don’t want to see kids and plan in-depth lessons for 90 minutes” (Interview, 12/3/08).

When I first met Mr. Torres, he had been at Tomasita for a year. He was respected by his teaching staff and was making a positive difference in mathematics achievement. Two of his fellow principals described him as “tough but there is something magic going on there. . . teachers want to go there and no one wants to leave” (Ms. Passos and Mr. White, Focus Interview, 1/20/09), and “Tomasita students are outscoring our students in math!” (Ms. Passos, Interview, 2/11/09). Although Tomasita students had not made AYP in mathematics in two years, from the time Mr. Torres started at Tomasita until three years later when this study ended, there had been small improvements on the state Standards Based Assessment.

Mr. Torres was driven by a strong sense of urgency about student success, as the following comments indicate:

We can’t send only 17 out of 70 kids proficient to the middle school! (Interview, 9/12/07)

I want these guys to be able to be functional when they get to the middle school, to be able to go into a math classroom and not be looked down on as “you don’t have the skills and you don’t have the concepts” (Interview, 12/3/08).

We can't do 500 field trips. You're not going to fix a kid's gaps by taking them to the lake fishing for a day. The only thing that's going to fix them is getting them to read and do math in Spanish or English (Interview, 4/8/09).

It is with this understanding of his commitment to the work that I turn to an analysis of his conceptions about leading the mathematics reform at Tomasita.

### **Mr. Torres' Conceptions of the Substance of the Reforms.**

*The subject of mathematics.* The fact that Mr. Torres enjoyed mathematics at a conceptual level was demonstrated not only in his words, but also in his response to doing mathematics. That he tended to hold a more fallibilist philosophy of mathematics was demonstrated during a focus interview when all three principals watched video excerpts of classroom instruction episodes. In one video, a teacher had given her students the task of representing  $6\frac{1}{4} \times 4\frac{1}{2}$  in a drawing to depict the multiplication of mixed numbers. She was trying to grasp from where her students' misconceptions arose. Mr. Torres seemed to be having fun analyzing and considering how students might come up with a number of different ways to represent fractional parts of a whole in the grid drawing to represent multiplication. When students in the video seemed to be confused about how to represent  $\frac{1}{4}$  and  $\frac{1}{2}$  in the grid, the teacher was unable to guide their thinking. He noted, "She's not asking them how they can show  $\frac{1}{4}$  and  $\frac{1}{2}$  in the grid array. Why doesn't she ask them to draw it?" (Classroom Observation, 2/10/09). He wanted her to provide students with more avenues for access to the problem. His own engagement with the mathematics of the problem and with the response of the teacher drew his rapt attention. Both of the other participants noted, "The one time we've seen Mr. Torres serious (in adult settings) was when he was engaged in the mathematics problems" (Ms. Passos and Ms. Rojas, 2/10/09).



*Teaching and learning mathematics.* A theme that permeated Mr. Torres' ideas about effective teaching for optimum student learning of mathematics was his belief that mathematics must be relevant – connected to students' lives. This notion of relevance is deeply intertwined with his beliefs about equity and opportunity to learn, as will be discussed below. He spoke of connecting to students' known experiences as critical to helping students construct meaning from prior experiences.

You've got to become aware of your students and what they know and reference your math back to that. You need to present problems in a way that relates to where they're from. That's my biggest challenge over here is trying to get these teachers to understand where they are in reference to the kids. What do Tomasita kids know? Where are they from? Kind of like the idea with the skateboard. You want to find their easiest reference point that's around them all the time. So cars are big out here. If it's geometry, you start talking about a car – 20-inch rims and how much gas they can get with 5 bucks. (Interview, 12/3/08)

As an assistant principal at the middle school level, he recalled observing a veteran teacher who was trying to lecture a group of frustrated 7<sup>th</sup> graders on the number of degrees in a circle.

B-o-o-ring! It didn't relate to them. They were checked out. I pulled him aside and I said, 'do you know what these kids love? Skateboarding!' And she was doing something in geometry! 'Why are you just saying 360 this, 360 that. I mean, you tell a kid to do a 360 on a skateboard, he's going to tell you exactly what it is!'  
(Interview, 9/12/0707)

As portrayed in his background story, Mr. Torres liked teaching mathematics. When talking about what he expected from teachers, he often referred to episodes from his own teaching practice. He spoke enthusiastically about how he taught using small groups and real-life problems.

I had a group over here that had no idea about order of operations and a group up here that was doing pre-algebra. Work with this group, work with that group. Then I'll come around and ask questions when all the little mini-lessons are done. Another teacher came up to me, a veteran teacher, and said it looked like pure chaos, but if you manage it, and you work it, they start moving up the ladder. (Interview, 4/3/09)

I had one group of kids who really got the math concepts so I gave them a challenge. I told them that we needed dirt for that big planter out there. So you know what they did? They even called to find out how much dirt costs, and they figured out how much dirt to order and how much it would cost! (Interview, 12/9/08)

These stories suggest that on the continuum of instrumentalist to problem-solving perspectives on teaching and learning, Mr. Torres leans more toward a problem-solving philosophy. He wants students to have access to manipulatives, to real world problems, and to working in groups to find reasonable solutions to those problems. He challenges teaching that is strictly procedural, as in the following excerpt:

I had one teacher who was hard last year. He was strictly an engineer and became a teacher. He had major discipline issues because, as I kept telling him, "They don't understand your board work. They don't understand the overheads. You have to get them in groups and start explaining to them in small groups, 'cuz if you get up and

lecture – these are seventh and eighth graders trying to figure out pre-algebra!”

(Interview, 4/2/09)

Yet he was also considering new ideas about how students learn mathematics. In another focus interview that involved observing a student doing mathematics, it became clear that Mr. Torres also believed that the teaching goal was that students get to one right answer. The episode involved a “star” fifth grade mathematics student who was able to do a complex subtraction problem and arrive at the correct answer, but her explanation of “borrowing” indicated that she had no concept of number sense and place value. Mr. Torres was very interested to learn that she had deep conceptual holes and said “I may not have looked for those holes if the student got the right answer all the time” (Focus Interview 11/20/07). He appeared to agree with the NCTM (2000) Teaching Principle, “teaching requires knowing and understanding mathematics, students as learners, and pedagogical strategies” (p. 17).

While he believed that student learning is the result of high quality instruction, and that teachers need to employ questioning techniques and make curriculum relevant for students, Mr. Torres acknowledged that teaching mathematics is complex and challenging for teachers. He clearly stated his own affinity for mathematics problem-solving in the teaching of mathematics, but Mr. Torres professed, “It’s hard to teach math . . . to really teach a kid to understand why. They (all teachers) can teach kids how to memorize, but concepts are harder” (Interview, 12/3/08). He believed that teachers were challenged by not knowing enough mathematics themselves and by the management skills required to effectively run small groups and give students autonomy for inquiry.

In a combination of interview statements and comments during classroom observations, Mr. Torres indicated what he looked for in an inquiry-based classroom. “I want to see drilling down deeper [into the mathematics]” (Interview, 12/3/08). “I want to see less teacher talk and more student talk. I was able to talk to him about his questioning, just listening to what the kids are telling you, not just what information you’re trying to get across” (Focus interview, 2/7/08). Again, he called on his own experiences as a teacher to express his beliefs and expectations:

When I was teaching, it was easier for me to get to those individual students in small groups versus whole group. So that’s my vision, is seeing a teacher get kids in groups and then be able to go to those different groups and listen to the discussions that are going on within those groups. It helped me as a teacher to get to those kids that have gaps ‘cuz you’ll hear them asking questions to each other and then you’ll say, ‘why did you ask that question’ (Interview, 2/7/08).

While these comments revealed a focus on attending to student thinking and connecting to students’ lived experiences, Mr. Torres’ comments also revealed a tendency to look first at teacher behaviors and the more “superficial” aspects of reform during observations. When I accompanied him on a ten minute observation in a 6<sup>th</sup> grade classroom, he commented, “I want to see more group work and more teaching that relates to kids’ experiences” (4/2/09). He spoke of wanting to see less teacher-talk, less direct instruction to the whole group. He did not look at student work, or comment on student responses. He noted on the classroom walk-through form that the teacher had eighty percent student engagement. When I asked him how he determined that, he said, “Students were raising their hands and they seemed to be listening to the teacher” (Conversation, 1/22/09).

**Curriculum.** The NCSM curriculum principle states that every teacher implements a curriculum that is coherent, focused on relevant and meaningful mathematics, is well articulated across the grades, and is “implemented with needed intervention to make certain it is attained by every student” (NCSM, 2008, p. 5). Mr. Torres believed in the need to improve mathematics teaching to address student learning through challenging and relevant curriculum, yet he received the district policy messages about the elementary mathematics curriculum (Investigations) and the middle school curriculum (CMP2) with ambivalence. Throughout the eighteen months of interviews, Mr. Torres never committed to a belief in full implementation. On a number of occasions, he confirmed that teachers who were fully implementing the curriculum showed greater gains on their short cycle assessment scores. But he also spoke of excellent teachers, getting high scores, who “did a little bit of everything to meet the needs of the kids.” He saw students and teachers getting excited and feeling successful with Dots and Grids and Number Literacy, the programs that the district had brought in to supplement the reform curricula. Some of his vacillation is evident in the following remarks:

He’s experimenting with different lessons, and I really want him to move toward the CMP stuff more (speaking of a teacher who is struggling with teaching mathematics, interview 2/7/08).

A teacher who did all Investigations, these last scores went down. It’s a balance – fourth grade uses it 85% and supplements with Dots and Grids and Number Literacy. (Interview, 12/3/08)

When I asked what he thought about full implementation, he said,

What perspective do you want? From a veteran teacher who can get results with anything? Cuz' one of my teachers didn't use Investigations last year as much and then she got her data mid-year and saw they were low [on the short cycle assessment] and she decided to do Investigations 100% the rest of the year. That's all she did and she got great results. Now she's going to go back and do the mix next year." (Focus Interview, 2/11/09)

In the previous quote, Mr. Torres expressed his equivocation, because he came to equate the teachers' improved scores with the implementation of Investigations. Yet in the same interview, he expressed continued ambivalence and concern about teacher choice. He had some teachers whose students were making significant improvement on the MAP assessments using an array of materials and approaches, while there were others who he felt needed more guidance.

My fear becomes, if you let them go that direction [choosing their own materials to balance their math program], you can let good teachers do that and they can find their way, but the ones that aren't strong, you lose everything that CMP or Investigations is really honing these kids to do. That's my fear that you go back to that place where kids are getting 20% on a standardized test (Focus Interview, 2/11/09).

But he also indicated that this differential treatment created some challenges in supervising teachers. He had a very strong third grade teacher who he described as loving math.

She does Investigations, but she does everything else, too, whatever she sees the kids need. Other teachers see her doing it and they want to do that, too. But they

can't. They should just teach Investigations because they don't know how to teach math in the first place. They don't understand it conceptually in their heads.

(Interview, 4/8/09)

If you're looking at your teachers, it's like differentiated instruction for your kids. I mean, for each one of my teachers, I'm looking at implementation in a different way. (Focus Interview, 6/2/09)

Supervising for implementation of the curriculum held other challenges for Mr. Torres. He admitted that he was not very familiar with either of the curricula. During the spring of the second year, he attended a CMP2 training with his sixth grade teachers in order to "learn more about the program so I know what I'm looking for" (interview 2/11/09). He rated his knowledge of the reform curricula at a three on a ten-point scale. His beliefs about the importance of curriculum fidelity seemed to shift during the second year of implementation. As his strong teachers began to the curriculum with more fidelity, he indicated a greater appreciation for the need for a combination of a strong teacher and a strong curriculum.

What about the teacher who can pull it all together from every which way and make it work, and then the teacher who said, 'I'm going to try Investigations for this semester' and her kids really did well. What the research shows is it's the curriculum plus the teaching. (Focus Interview, 6/2/09)

Yet in the same interview, he vacillated, "I would let my veteran teacher who's getting good results not go with this [curriculum] pacing guide, versus another teacher who I would have try to keep up (Interview, 6/2/09).

*Assessment and data.* The PSSM (NCSM, 2008) assessment principle states that leaders should “ensure timely, accurate monitoring of student learning and adjustment of teacher instruction for improved student learning” (p. 45). While Mr. Torres clearly believed that good teaching requires listening to students and adjusting instruction to meet their academic needs, he was particularly focused on summative assessment. When he talked about data-driven decisions for instruction, he favored summative data. Out of over seven hours of interview tapes and researcher memos from three classroom observations, more than 35% of his comments had to do with short-cycle accountability, or MAP data. Mr. Torres was called “the data guy” by his peers. He did his masters thesis on short cycle assessments, and ‘how to use them to help guide your instruction” (Interview, 9/9/08). He was the one who “understood it enough to explain it to all the middle school teachers” (4/2/09) when he was assistant principal. Each time we met, he had MAP data charts at his fingertips, and could point out which classes were making progress and which concerned him. He felt the district accountability press very acutely, perhaps because he knew so well how summative assessment data could be used to designate quality – proficient students, quality teaching, and quality schools. He knew that he would have to make a presentation to the superintendent and the board in January using graphs to show short cycle assessment progress of all teachers in all grade levels. He chose to use that short-cycle assessment data to press his teachers, as well.

I brought every teacher in at the mid-year and went through this [MAP] data with them to make sure that they know how to look at their data. I sat down with each teacher. So this is Ms. J. This is the MAP scores for her class. This is her baseline. We compare and see how much growth in the winter scores. Then we look at their



nine-week lesson plans for the two previous nine weeks . . . and you start seeing trends. Like with this teacher, you see this blue line in math went down. She was focusing on her numbers and operations and doing a lot of the math Investigations, but not covering data and probability. I'm trying to get teachers to look at the low areas and start planning lessons to these particular areas. (Interview, 4/8/09)

After the winter MAP test, I go into every class and show the teacher and the kids how they did and where they need to work harder (Conversation, 2/7/08).

He also spoke of how he wanted teachers to use data from both the short-cycle and the annual standards-based assessment (SBA) to drive their instructional planning. Each fall he gave his teachers results from the previous year's SBA assessment and had them "manipulate it and analyze it based on the class they are getting" (4/0/09). During fall of the previous school year, he taught his teachers how to "data drill" into the assessments to find the strengths and weaknesses of every student in their classes in mathematics. "I showed them how to go through their data, through those five [curriculum] strands and where the kids were lacking, if they had taught that in math, and that went back to the pacing" (Interview, 12/3/08).

Mr. Torres rarely spoke of using formative assessments such as looking at student work, either with individual teachers or collectively, to learn more about student misconceptions. When he discussed formative student assessment in mathematics, he often focused on the teacher during small group work. In a focus interview (Classroom Observation, 11/9/08), we looked together at the video of a fifth grade girl who could complete a subtraction with borrowing algorithm, but could not explain the place value and concept of borrowing. He was very astute in noticing her lack of number sense and where

she had “gaps,” but admitted, “I never would have seen that she didn’t get the concept.” Yet in the context of his leadership role, he did not speak about guiding his teachers to delve into student understanding and misconceptions. At one point, he indicated that curriculum-based and teacher-created formative assessments were important future goals for teacher learning, “but to get the bigger picture they start by using the short cycles that are done three times a year and build on that” (9/9/08). Without a deep understanding of the curriculum, he relied on his strong background in short-cycle assessments to guide teacher pedagogy.

***Opportunity to learn.*** Mr. Torres placed great emphasis on his belief that teachers needed to maintain high expectations for students to become proficient and succeed in mathematics. He believed that his teachers needed to improve their teaching to help all students become proficient. “A teacher came to me the other day and complained that I was pushing too hard, and said, ‘I had 60% of my class proficient or advanced. What’s the problem?’ And I told him, ‘What’s the problem, you ask? What if I was one of the 40%? If I’m part of the 60% it looks pretty peachy. But if I’m one of the 40, it’s not lookin’ so good!’” (Interview, 9/12/07).

This quote was representative of Mr. Torres’ urgency that every student reach proficiency. He stated several times that a teacher’s goal should be 100% proficiency. It was not right to accept that any student did not do well in mathematics. A key driver for Mr. Torres’ leadership was his expectation that all students could learn relevant and rigorous mathematics, if the teaching pedagogy were effective. He voiced several times that no student should be allowed to fail. Mr. Torres believed that opportunity to learn involved

how teachers invited all students into the rich world of mathematics. “It’s the teaching, not the students.” Good teaching made mathematics “functional” or meaningful for all students.

It’s not about making teaching easy. It’s about making teaching functional for kids.

My goal is for these guys to be functional when they get to the middle school, to be able to go into a math classroom and not be looked down on as ‘you don’t have the skills, you don’t have the concepts. (Interview, 9/9/08)

From his perspective, the discrepancy in the performance between Anglo and Hispanic students on the NAEP was the result of two issues. First, he believed the fundamental issue was one of poverty. “It’s not a language issue. Our ELL kids outscore our non-ELLs. Kids on this side of the river just don’t come with basic skills” (Conversation, 1/22/08). Mr. Torres’ reference to “this side of the river” was a theme in his discussions about poverty. In the town of Las Palmas, the majority of the free and reduced lunch population lived east of the river, and Mr. Torres recognized that there were preconceived ideas about whether his students would be successful.

Second, he believed that schools could provide access for all students to learn, and for him, the key lay in relevant instruction. “It means trying to understand where the kids are from. I’m trying to get these teachers to understand what these kids know. What did they grow up with?” (12/3/08). He gave examples like how much the Mexican immigrant kids like cars. “They love anything to do with cars, trucks. So talk about the cost of five gallons of gas. Talk to them about the diameter of a tire” (Interview, 12/3/08). He exemplified his enormously popular fourth grade teacher, whose students scored highest on the MAP assessment:

Ms. R. changes her teaching based on who her kids are, where they are from. Like some years she has more from Loma Vista [very high poverty area] or some rural kids who bale hay. She becomes aware of what they know and references her math back to that. (Interview, 4/8/09)

He believed part of connecting mathematics to students' experiences and lives was a means of developing relationships with them. For example, when talking about the large population of Hispanic students served by his school and the feeder middle school, he stated,

Hispanic kids like to be related to more than anything else. They want to make a connection. If you make a connection with them, they will work their tails off for you. But if you make a connection only with the math, not with them, it won't work. You find out what they like and what their families like. In the middle schools we have here, they're not making connections with middle school kids. (Interview, 4/8/09)

Mr. Torres stated often that making mathematics connect to students' lives was critical if teachers were going to engage students in their own learning. He believed that elementary teachers had a responsibility to empower students with a strong mathematics foundation. He conveyed his deep concerns about what happens to students who matriculate to middle school with weak mathematics backgrounds and low expectations from teachers who work with them. He made the following comment in a final focus interview (6/2/09):

Once kids go into Ramp-Up [the intervention program] in middle school it's double down, triple down. It makes everything worse for them in other areas. You get stuck in Ramp-Up for two periods, you're probably in the reading intervention, too. That's

all you do, and you become a behavior problem. When I was AP at the middle school, I would say seventy-five to eighty percent of my behavior issues were out of the kids that had Ramp-Up. (Interview, 4/8/09)

Mr. Torres was deeply concerned about the ways he had seen middle school limit ELL students' opportunities to learn mathematics. In a focus interview, looking at SBA scores across grade levels in several schools, he noted that for ELL students, their mathematics scores were higher than non-ELL students in third grade, and then began to drop.

On the third through 6<sup>th</sup> grade, you notice that in each one of those schools 3<sup>rd</sup> grade ELL has a higher percentage than the non-ELL, but then it never happens again. A lot of kids go into Ramp-up in the middle school and once they go into Ramp-up, it affects the rest of their schedule. It affects what literature class they're in and what opportunities they have for electives such as band or art. (Focus Interview, 2/7/08)

In addition to relevance, Mr. Torres seemed to be trying to make sense of the issue of language in the mathematics classroom. He seemed conflicted in his ideas about how to meet the learning needs of ELL students. In his own teaching, he did not see language as a big barrier. "I could translate some in Spanish, and I'd always pair a monolingual student with a bilingual one" (9/12/07). At one point, in talking about why mathematics should be important for all children, he stated that math is a "universal language," that for Mexican children, it's part of their language. "Look at the Mayan and Aztec calendars, look at all the math in there" (Interview, 9/9/08).

Yet, by the end of the second year, he talked about instructional decisions he had made that reflected his belief that language of instruction does matter. He came to decide,

over the two years I met with him, that in some cases, teachers should just teach mathematics in Spanish. He told of working with a bilingual third grade teacher who was teaching reading in Spanish and mathematics in English. Her students' winter MAP scores were very low. So Mr. Torres told her, "You have to teach more math in Spanish because if those kids understand it better in their home language, they're going to do better. They'll pick up the English as they come along" (Interview, 9/9/08). He said she was very upset and fearful at first. "She cried and said, 'I've never taught *math* in Spanish.'" But she followed the directive and did well, so her spring MAP scores were the best of all three third grades. This vignette indicates that Mr. Torres had knowledge and understanding of some of what is documented in the best practice research. Researchers suggest that language should not be a barrier to access to academic content and teachers must consider the language of instruction and discourse in the mathematics classroom (e.g., Khisty & Morales, 2002). However, he reflected a different view when, in another interview, he asserted, "We have to get them proficient in math in English for the test. They take the test in English." When asked why he didn't have more students take the state test in Spanish, he indicated some uncertainty about the state policies related to the language of the SBA. He believed that since most of his students had been at Tomasita since Kindergarten, they had to take the test in English. In fact, the rules are that students must take the test in English if they have been in U.S. schools for three years, beginning in first grade, which means any third grader can take the test in Spanish. Also, a waiver can be granted for up to two years for students who are not English proficient (from state Public Education Department of Accountability website, 2009). His uncertainty related to language of instruction was in part due to his misconception that students could not take the assessment in Spanish. He asked me for this

information, and I was surprised that the Bilingual coordinator had not clarified this for all administrators the year before.

A final role that became a theme for Mr. Torres related to opportunity to learn were his efforts to involve parents in understanding what their children should know and be able to do in mathematics. He held well attended parent meetings to explain the standards-based report card and the mathematics strands. He believed that “parents need to know what their kids are expected to do in math” (12/3/09) and conducted several community meetings to share standards information and MAP data with parents. He included parents in the efforts to systematize the improvements and drive to prepare every child to succeed mathematically.

**Sense-making and District Policy Representations.** As explained previously, the district put a heavy emphasis on accountability, asking for frequent data updates and pressing principals to improve scores on short cycle and standards-based assessments. This was an expectation that Mr. Torres related to and accommodated this expectation, as he was very comfortable in the world of accountability data. He took the press from the district for improved test scores very seriously and had charts and graphs of student performance in mathematics by each grade level and each teacher. He believed that an important leadership role was representing the data and sharing it with teachers in order to press them to improve their teaching. He brought individual teachers into his office to share their class results on the short cycle assessments three times a year. In addition, he made the scores of each teacher public at grade level meetings, hoping to put pressure on some teachers “to ask what the teachers with more proficient students are doing” (Conversation, 1/22/09). “I think overall the district requirement for MAP has helped teachers focus more on what they need

to start teaching in math. It helps at the school site if you're pushing, pushing, pushing" (Focus Interview 6/2/09). He also revealed a bit of his competitive spirit when he spoke of making a mid-year presentation of his data to the school board and superintendent. He stated that he "knew we would look better than Sands but we wanted to beat Camino Real" (Interview, 4/8/09).

What the district asked of principals in terms of representing their progress through assessment data, Mr. Torres asked of his teachers. "I went to every classroom and shared the MAP data with the teacher and the students. I showed them, 'you were here, now you need to get to here (referring to the expected growth, or RIT score'" (12/3/08). He tracked every teacher's class scores and progress after each assessment, fall, winter and spring.

Mr. Torres was clear about the district policy messages of implementation of Investigations and CMP2 in all classrooms, but viewed full implementation as a somewhat elusive goal, both for the district and for the school. At a principals' meeting, when the superintendent asked what percentage of teachers were implementing the program at each school, he replied, "Most of the principals said that 60% of their teachers were implementing the program, but since many of them don't recognize the program, I bet that isn't true. Besides, how much of the program do you have to do to be saying you're doing it?" (Interview, 5/29/08). He was clear that the district policy message was to implement the new curricula, and in his school, no money was being spent for other mathematics textbooks. However, he was also clear that the only supervisory accountability to implement the programs with fidelity was his leadership within the school.

As for the district policy to observe in the mathematics classroom, Mr. Torres said that it had been difficult to comply. "I think it is a good idea. I just can't get into that many



classrooms every week” (Interview, 4/2/09). When I went with him into classrooms to observe, he did not take the walk-through checklist that the district had developed for giving teachers feedback. One time, he asked to borrow the one I was carrying as a reference, and he used it to make note of student engagement and to ask a couple of questions like, “Do you have a word wall?” or “When do they do small group work?” (Classroom Observation, 2/10/09). There was evidence that he did use the checklist on occasion, as his assistant principal stated, “I didn’t used to write anything; I just checked off. Then I saw that teachers were coming to Mr. Torres to ask him about his comments, and I saw that it promoted conversation with teachers” (Focus Interview, 6/2/09).

Because Mr. Torres felt that no one was really holding principals accountable for the walk-throughs, he interpreted the “policy” as guidance, even an expectation, but one that he could modify to meet the needs of his school. He particularly focused his walk-throughs on teachers that he, himself, wanted to press either to use small groups for mathematics instruction or to implement the curriculum.

Mr. Torres adhered to in his own beliefs and ideas about the fourth policy area of holding schools accountable for all students to learn. His focus was “all students can meet proficiency. Some need more time and support” (interview 4/2/09). However, the NCLB mandates that traditionally underperforming subgroups be monitored and show greater proficiency in mathematic, was not where Mr. Torres had placed his focus. While at every interview he had current MAP data in charts and graphs, when I asked for data specific to Hispanic students, ELL students or FRL students, he did not have it readily accessible, nor could he quote it. Perhaps this was because “We don’t even have a Caucasian subgroup this

year. We only have twenty Caucasian kids,” and also because, “our ELLs outperform the non-ELL kids” (2/11/09). In general, his focus was on every child, not on subgroups.

In sum, Mr. Torres felt that the district policy press was strong in the area of data and accountability. With the state and district press for improvements in MAP and SBA scores and with his own background knowledge, Mr. Torres was confident in his ability to lead his teachers in data-driven decision-making based on short-cycle assessment scores within the five curriculum strands of mathematics (referring to NCTM content strands). He considered the district policies related to the mathematics reforms and curriculum fidelity to be more guidance for schools rather than a directive, since there was only building level accountability, and the messages about other programs like Dots and Grids diluted the fidelity expectations. Because his own beliefs about curriculum fidelity were ambivalent, he mediated the messages about curriculum implementation through his own mathematical understandings and judgment of effective teaching. Teaching where the students were highly engaged and the MAP scores were high was good teaching, and he felt his strongest teachers were effective by pulling from a number of curriculum sources, while his weaker teachers needed the reform curriculum to guide them.

**Conceptions of Leadership and Adult Learning.** Leadership content knowledge includes more than a leader’s understanding of the mathematical intent of the instructional materials and lessons. It encompasses knowing something about teachers as learners and how to guide and facilitate their learning (Stein & Nelson, 2003). It also involves holding teachers accountable for implementing new learning (Nelson & Sassi, 2005).

Mr. Torres recognized that teachers needed time to improve their mathematics instruction. “It’s a process of time and consistency, just like in your classroom. I have to

remember that” (2/7/08). But his sense of urgency for improving student learning was coupled with an admitted impatience with the pace of teacher learning. “I shift when I work with adults. I don’t have as much patience as I do with kids. Sometimes I have to bite my tongue” (Interview 2/7/08). In analyzing the data, it became evident that Mr. Torres articulated three general beliefs about what his teachers needed in order to improve their teaching: accountability press to improve their students’ MAP scores in mathematics; expert advice on teaching strategies; and professional learning communities where they shared best practices.

Mr. Torres believed that teachers would be inspired to improve their mathematics teaching if they were held accountable for student proficiency on the MAP assessments. He believed a bit of competition could motivate struggling teachers to change and to ask for advice, so he shared each teacher’s scores at grade level meetings. “I showed them all the kids who were and were not proficient, based on MAP scores, and it showed a backslide of kids in some teachers, and there were some hard discussions about that” (Focus Interview, 2/7/08). He hoped that if Ms. D’s scores were high, Ms. M. would want to know how she did it, and learning communities would form.

Mr. Torres also believed that teachers needed expert guidance in order to improve their practice. Because his academic coach was not “expert,” he relied on his own strengths as a mathematics teacher to guide teachers in developing more effective teaching strategies, which was evident in his frequent use of verbs like, “I told her to . . .” and, “I strongly suggested.” The guidance he spoke of was particularly focused on three general areas: making mathematics relevant and meaningful to students’ lived experience; giving students opportunities to work on problem-solving in small groups with less “direct instruction”; and

making sure students were progressing on the short-cycle assessments. He did not know the curricula, and thus did not speak of supporting teachers with curriculum use. In fact, since he did not hold all teachers accountable for implementing the reform curricula, he did not have strong models to guide the weaker teachers in implementation.

Mr. Torres hoped that some improvements in teaching and learning would come about through professional learning communities (PLCs). He felt teachers needed regular professional conversations with their peers to ensure some consistency in addressing the standards. However, he delegated the facilitation of the PLCs to his academic coach, who was not strong in mathematics. “I need [the coach] to be there making sure they’re talking about the five [mathematics] strands and looking at their data to see where the gaps are” (Focus Interview, 2/7/08). He did not talk about a focus on the curriculum or pacing the units. There were no comments in the data to reflect a concern that teachers needed support in learning to implement the adopted curricula, only that they develop more effective teaching strategies.

In terms of holding teachers accountable for new learning, Mr. Torres relied mostly on MAP student assessment data, but also on what he observed to be good teaching. He spoke often of one sixth grade teacher who presented a challenge in this area. Mr. Torres had hired Mr. M. shortly after the reform initiatives began. Mr. M. had experience teaching CMP and working with middle school students. Mr. Torres was pleased with the classroom management, but concerned that Mr. M. spent a lot of time in front of the whole class delivering instruction. Mr. Torres had spoken to him on a number of occasions about using more small group work and having students discuss their thinking, but over the two years of the study, Mr. M. did not change his delivery. While Mr. Torres was pleased with the level

of curriculum implementation, he continued to press Mr. M. to modify his pedagogy. At the end of two years, Mr. M. chose to move to another school, which left Mr. Torres conflicted about the degree to which he could hold teachers accountable.

**Summary: Conceptions of Leading Mathematics Reform Initiatives.** A major premise of this research has been that principals' conceptions of their leadership role are influenced by their conceptions of mathematics, the leadership principles related to mathematics, and their sense-making related to policy representations and social context. The literature offers three general responsibilities of leadership in any kind of reform environment: setting direction, developing people, and redesigning the organization (Leithwood et al., 2004). Using these three categories, I summarize Mr. Torres conceptions of his role in leading the mathematics reform initiatives in his school.

**Setting direction.** Mr. Torres set a clear direction for the reform of mathematics teaching and learning: improve student proficiency on the MAP short cycle assessments and on the SBA. He expected teachers, with his guidance, to learn to understand and use their student assessment data to improve and fill gaps in their instruction. He included parents in data literacy and the drive to improve student mathematics proficiency by teaching them to understand the mathematics standards their children were expected to achieve, and by asking teachers to explain each student's MAP proficiency to parents.

He also set a direction for making mathematics accessible to all students by guiding teachers to find connections to students' daily lives, to employ more small group work in their teaching, and to find interventions for struggling students. He emphasized this in individual comments to teachers, as well as talking with groups of teachers at staff meetings about addressing "teaching gaps." He expressed strong beliefs about sending Tomasita

students, students “from this side of the river” on to middle school with a fighting change for success.

Classroom observations and “look fors” also served to indicate to teachers the direction Mr. Torres promoted for teaching and learning. He emphasized less teacher talk and more small group work. He let teachers know he was looking at student engagement and involvement with mathematical problems. He spoke about “telling” and “discussing with” teachers the ways they could improve their instructional practices for greater success with students.

He did not set a clear direction for curriculum implementation. He felt that district policy on the curriculum was one he could broker with teachers according to what the data was saying about student proficiency. If the scores were strong and improving, and the teacher was “pulling from everywhere,” he let it be. He felt that the weaker teachers needed to implement the new curriculum to help them develop pedagogy. But this created a dilemma. In the spring of the second year, he realized that the teachers who most needed a strong model “would not likely be able to model the practices of [the stronger teachers]” (Interview, 4/2/09) who were patching together their own curriculum.

***Developing people.*** To develop teachers’ ability to achieve the performance goals he had so clearly set, Mr. Torres felt that the role of support and guidance fell to him. Relying on his own sense of success as a mathematics teacher, Mr. Torres determined that it was up to him to emphasize mathematics instruction and “compensate for our coach’s not having enough math training” (Focus Interview, 2/11/09). He spoke frequently about his conversations to re-direct teachers toward small group work, more relevant instruction, and attention to individual learners. His references to professional development opportunities for

his teachers were infrequent. Although organizationally he supported two groups of teachers who were involved in Mathematics Lesson Study (described in Chapter 5), he did not attend the planning, the teaching or the debrief sessions. In terms of supporting teachers to implement the adopted curricula, he spoke only of his frustrations with the professional development provided by the district the first year and of one CMP2 training for his sixth grade teachers the second year.

One avenue for developing teacher pedagogy for mathematics that seemed to be evolving for Mr. Torres and his staff was professional learning communities. While he fully supported and even mandated attendance at the PLCs, he did not attend. He “advised his coach” about agendas and how to facilitate, but he was not there to personally “set the direction.” He did not revise this thinking much even after attending a conference on PLCs, continuing to believe his role was to guide his coach in the facilitation and to work with teachers one-on-one.

What was also significant in the data from interviews with Mr. Torres was the *lack* of comments related to the professional development needed to support teachers in understanding both the intent and the enactment of the reforms. The research is quite clear that all teachers, even strong teachers, need professional development and coached classroom practice with the curriculum over time in order to become effective in implementing it (Ball, 2000; Cohen & Ball, 1999).

***Redesign the organization.*** As far as redesigning the organization to accommodate the reforms, Mr. Torres did not identify himself as playing a strong role. He made some minor adjustments to the schedules to ensure that teachers had common planning and PLC time each week. For mathematics teaching and learning, he required that teachers schedule a

60 - 75 minute math block each day. While on the surface that schedule appeared to align with the curriculum policies, he spoke of a number of classrooms where teachers did the Investigations lesson for 45 minutes and then worked on procedural proficiency and number sense with the supplemental programs. He spoke of the arrangement in the sixth grade where two teachers taught all students math. They switched after 45 minutes, with one teaching CMP2 and the other teaching basic procedures and skills.

In sum, Mr. Torres believed that reform was a process, and teachers needed time to improve. “It’ll take two or three years, but eventually, if we keep this up, kids will get better, and we’re already seeing it in the pipeline of Tomasita” (4/8/09). How teachers learned new teaching strategies was the result of a two-pronged approach in Mr. Torres’ conception. First, he believed that his leadership attention to mathematics, through “talking with teachers” or “making strong suggestions” and “going into classrooms” had pressured many teachers to adopt new approaches. Second, the press to improve student proficiency forced teachers to look at their practices. He had the weight of district policy in his court when pressing teachers to improve their students’ proficiency levels. But it earned him some “push back.” He had teachers call the Teachers’ Union after he gave a directive about their teaching. Some teachers grew frustrated, and “rather than change, they left.” For Mr. Torres, that move was the right thing, and it opened the door to hire more skilled and qualified teachers. However, finding qualified mathematics teachers was not easy, and sometimes even losing even a mediocre teacher was disappointing. “It’s a delicate balance between giving a teacher the right coaching and the right press. I’m going to lose Mr. M. [sixth grade teacher] because he wants to go back to middle school.” These were Mr. Torres’ words in April of 2009. Mr. M. was the sixth grade teacher he had told, suggested,



asked, and finally pressured to talk less and listen more to students. Finally, he admitted that he was afraid to lose a teacher with good discipline, in spite of the fact that Mr. M. was resistant to change.

I'm kind of sad. I pressed him hard this year to get better with reading, which in my mind would have made him a better math teacher. But I pressed him too hard. He felt uncomfortable with that. He tried, but it wasn't going to work. What I fear is at some point you lose some of these teachers that are just consistent. You need consistent, and he was consistently mediocre. He never had discipline problems and he could get the kids to learn something. (Interview, 4/2/09)

But if Ms. Passos and a fellow principal were right, Mr. Torres was building something special at Tomasita. Teachers wanted to go there to teach. Fewer students were matriculating to remedial mathematics courses in middle school. Families seemed to be involved and pleased with the educational rigor. Figure 6.4 represents a synopsis of the significant findings related to Mr. Torres' conceptions of leading mathematics reform at Tomasita Elementary.

<b>Mr. Torres Conceptions of Leadership for Mathematics Reform</b>	
<p><b>LCK:</b></p> <ul style="list-style-type: none"> <li>• Mathematics</li> <li>• Teach/Learn</li> <li>• Curriculum</li> <li>• Assessment</li> <li>• Adult Learners</li> </ul>	<ul style="list-style-type: none"> <li>• Strong sense of agency as mathematics teacher               <ul style="list-style-type: none"> <li>○ Took role of coach/guide for teachers</li> <li>○ Set direction for improved achievement in mathematics for all students – Leads with “can do” attitude</li> </ul> </li> <li>• Ambivalent about curriculum fidelity               <ul style="list-style-type: none"> <li>○ Didn’t know curriculum well enough to supervise</li> <li>○ Strong teachers got high proficiency with their own material</li> <li>○ Believed reform curriculum best for weaker teachers, but no models for weaker teachers to learn from</li> </ul> </li> <li>• Sense of urgency about improving mathematics proficiency (opportunities) for traditionally underserved students.               <ul style="list-style-type: none"> <li>○ Stressed making mathematics problems relevant to students lived experience.</li> </ul> </li> <li>• Heavy emphasis on MAP data to drive instructional improvement - pressed adult learners</li> <li>• Looked for small group work, less teacher talk, student engagement</li> <li>• Saw himself as sole support and guidance for improving mathematics instruction, yet did not attend teacher PLCs.</li> </ul>
<b>Policy</b>	<ul style="list-style-type: none"> <li>• Strong sense of agency for data-driven decision making using short-cycle assessments.</li> <li>• Very “in sync” with district accountability policy</li> <li>• Very ambivalent about curriculum policy</li> <li>• Saw role of walk-through as way to emphasize mathematics and to “press teachers” to improve instruction.</li> </ul>
<b>School Context</b>	<ul style="list-style-type: none"> <li>• Modeled culture of respect for all - knew students/parents names</li> <li>• Included parents in understanding standards and MAP assessments</li> <li>• Believed role was to create “can do” attitude for teachers and students.</li> <li>• By second year, was considering playing a greater role in PLCs.</li> <li>• Took hiring of new teachers with strong mathematics skills very seriously</li> </ul>

### **Ms. Passos – “The Systems Person”**

**School Context.** Camino Real elementary school had strong roots in the Las Palmas community. It had served families through several generations, and some of the children attending at the time of this study had the same teachers their parents had had. The

school is located in a small village just to the north of Las Palmas, but is part of the Las Palmas district. Like Tomasita, Camino Real also added fifth and sixth grades just as this study began, bringing its student population to 430. The school was considered one of the “better schools” in the community because they had consistently made AYP. Camino Real served children from mostly middle to upper middle class families, many of whose parents worked in the larger city to the north and like the convenient location along the main highway out of town for dropping off their children. Ms. Passos described the community as very tight knit and confident in the school’s educational programs, although those programs had changed little over time. This meant some significant challenges for a principal who was invested in change and growth to meet the needs of students. “Sometimes the expectation is that things will be the way they always were, and that has made it difficult to implement change” (Interview, 11/15/07). In an earlier interview, she expressed how a traditional policy of allowing parents to choose their child’s teacher was creating problems.

Tradition can sometimes get in the way of progress. Some teachers and parents expect that things will be the way they have always been. But, for example, I have a dynamic new teacher in the sixth grade that all the parents want, but I can’t overload this teacher’s class (Interview 9/14/07).

These obvious parent preferences caused jealousy among teachers just as Ms. Passos was trying to establish an environment of trust conducive to collaboration. Because the staff had been so stable, it meant the staff culture was also very strong-willed. When Ms. Passos first arrived, she thought the staff was very sweet and friendly to one another. “But I soon came to discover that under the surface there was a great deal of passive-aggressive

hostility that was hurtful and led to an underlying distrust of one another. Teachers practiced isolation as a result. It's my goal to get them to collaborate more" (Interview, 9/10/08).

The student population was 60% Hispanic, although there were less than thirty ELLs in the entire school. Most of the teachers were ESL certified, and several had bilingual certification. A collaborative team met once a month to consider how to implement a dual language program, invite more Spanish speakers to the school, and teach Spanish to their English-only students.

**Ms. Passos' Mathematical History.** Ms. Passos grew up in a family of educators, and there was never any question that she would go to college. "I'm Hispanic, but my family doesn't have the traditional (southwest Hispanic) background. Three of my four grandparents went to college." At age four, she told her parents she wanted to be an astronaut, to which her parents replied, "Great! You will need a lot of math and science!" In fifth grade, Ms. Passos found a book and taught herself algebra. "It never occurred to me math was hard" (Interview 9-14-07). In the eleventh grade, Ms. Passos attended a NASA summer workshop, and went on to participate in a NASA program at the university.

In college, she coached a high school girls' basketball team, which was when her interest turned to education. She joined the math/science cohort for student teaching, and obtained her teaching certificate. She became a kindergarten and first grade teacher for ten years, seven of which were at Tomasita Elementary. When reflecting on her strong interest and ability in mathematics, and teaching kindergarten, she laughed, "People thought that because I taught Kindergarten, that was the level of my math skills" (Interview, 9/10/08).

As a teacher at Tomasita, Ms. Passos became interested in instructional leadership. She was invited to be part of a team that learned reflective practice and collaborative

support for improving pedagogical practices. “That was the first time I realized that I was a professional! I really wanted to become an instructional leader” (Interview, 12/3/07). So she went on for her administrative license and a master's in curriculum and instruction, with an emphasis in bilingual education. She became the assistant principal at Tomasita, and began to work on developing stronger teacher collaboration, Critical Friends study groups, and a dual language program. In 2006, she became the principal at Camino Real Elementary.

Key to understanding her conceptions of leadership was her own self-description as a “systems person.” As will be seen in her leadership content knowledge, she thought in terms of big drivers like standards and professional learning communities. She was always interested in how the parts serve the larger system, a belief that undergirded her sense-making about the leadership role.

### **Ms. Passos’ Conceptions of the Substance of the Reforms.**

*The subject of mathematics.* Although Ms. Passos’ last higher-level mathematics course was in high school, she felt she had a strong mathematics background and was comfortable with mathematics. She demonstrated energetic interest in mathematics problem-solving during the focus interviews that involved a mathematics problem. There was a spirit of competition with Mr. Torres when they played a game finding factors. When the group was presented with the task of finding area with mixed numbers, she constructed a drawing to represent her ideas about the solution. “You could put both of the fractional parts in this corner and you see that you get  $\frac{1}{4}$  of  $\frac{1}{2}$ ” (Interview, 5/29/08). When she viewed a video of students working to solve the same problem, she was able to see multiple approaches to the problem.

Ms. Passos tended toward a more fallibilist philosophy of mathematics, in that she believed “there is more than one way to solve most problems, and sometimes more than one right answer” (Interview, 11/7/07). However, she indicated a concern with teaching methodology that encouraged students to take time to “figure out the answer themselves” if it meant slowing down the pacing of a lesson.

***Teaching and learning mathematics.*** To be successful in mathematics problem-solving, Ms. Passos believed that learners of all ages needed to be able to think more conceptually. A story she related from working with adult learners captured the fact that she was a conceptual thinker who tended more toward a problem-solving approach to teaching mathematics.

The most rewarding experience for me was working with adults who were learning math. My educational assistant was going to school to get her teaching certificate, and she was struggling with math. She came in one day and said she just didn’t get what all those little numbers meant (describing exponents). So I pulled out the Unifix Cubes and told her to pick a number – kind of small because I didn’t have that many Unifix Cubes. She picked eight. So we made a square that was eight by eight. I asked her what it looked like. She said, “A square. . . Oh, that’s why they call it eight squared!” Then I told her to make a shape that was stacked eight high. I asked her what shape that was. She said, “A cube. . . Oh, that’s why they call it eight cubed!” It was so rewarding to see the learning for a grown person who’s gone through life thinking she couldn’t do math. (Interview, 9/14/2007)

Ms. Passos could see the connections between Kindergarten pattern activities in mathematics and high school algebra. This recounting of her own “teaching” practice

demonstrates that she understood mathematical “big ideas” (Ball, 1999), and that she believed that individuals construct meaning based on what they know. When explaining her beliefs about what students need to know and be able to do in mathematics, she stated, “They need to demonstrate their understanding with write, draw and discuss. They need to be able to reason and communicate” (Focus Interview, 9/24/07). When she observed in a mathematics classroom, Ms. Passos expected to see students working in groups, able to discuss their thinking, and writing about their thinking in their mathematics journals. “I’m fine if the teacher is modeling to the whole class some of the time, but there should be a lot of group time and problem-solving work” (Interview, 9/14/07). She related an example from an observation in a first grade classroom. The student journals “were incredible!”

One little girl, who the teacher identified as having middle ability in math, had written, “My dad had 10 motorcycles. He bought some more and now he has 20 motorcycles.” Then, below that she had written the math sentence  $10M + \underline{\quad} = 20$ . Isn’t that fantastic! The teacher shared that with her parent. (Interview, 9/14/07)

The teacher’s role, one that Ms. Passos looked for in observations, was to be clear in her mind about “what her objectives are and what she is focusing on. “That helps eliminate confusion for the students” (Interview, 4/2/09). On one set of classroom walk-throughs where we visited two different sixth grade mathematics lessons, she pointed out differences she noted in student engagement and understanding. She noted how students in the second classroom were more engaged and were talking together about the mathematics “because the teacher had her objectives for student outcomes so the students were able to articulate to her what they were learning” (Conversation, 5/4/09).

While a strong advocate of constructivist teaching in general, and a problem-solving or inquiry approach in mathematics in particular, over the two years I spent with Ms. Passos, she also revealed that she was not completely comfortable with letting students struggle through misconceptions with mathematical thinking. For example, she explained in a March 2009 interview that she had actually taught a CMP2 lesson so one of her teachers could attend professional development. She noticed one boy did not seem to understand.

I've got to tell you, the hardest part that day – it was so hard – was not giving the kids the answer. I didn't anticipate that it would be so hard. We preach guiding questions, but when you look across the room and you see little Dillon with that look of confusion . . . so I have to admit. I cheated. I took him aside and I retaught number lines until he understood it. (Focus Interview, 2/11/09)

In another case, the three principal participants met for a focus interview (4/12/09) and we read an excerpt of a teacher who presented a division problem,  $39/5$ , to her students (Appendix E). One of the students stated the problem as  $5/39$ . The teacher asked her students, "OK, can we divide 5 by 39?" and a discussion with the class ensued. Ms. Passos said, "I was getting uncomfortable with the mistake, and I wanted somebody just to divide 5 by 39 so they could see what the answer was instead of all the questioning." She appeared to be attempting to reconcile her own experiences and beliefs with what she knew from the research to be best practice. Her beliefs about developing a classroom for inquiry were also sometimes in conflict with her sense of urgency. "We don't have time to spend days on waiting for kids to figure out the right answer. There is too much to cover by the time they take the test in March" (Focus Interview, 3/11/09).



While she was working to reconcile her beliefs about teaching and learning with her sense of urgency for student success, Ms. Passos often returned to her belief that the foundation, the guide for teaching and learning, was the standards. “You have to look at [teaching math] from a standards point of view. When you really understand what the standards are, then you start matching activities to the standards. You chose a lesson to present on ratio because your goal is to teach ratios, not because it’s an interesting problem” (Interview, 4/2/09). So when she observed in a classroom, she expected to be able to determine the standard the teacher was addressing. In fact, for her, the standards drove everything. “I think of standards as being a system. It’s not just the curriculum, it’s materials, it’s the standards themselves, it’s the assessments. Is it all aligned?” (Focus Interview, 2/11/09).

**Curriculum.** Like Mr. Torres, Ms. Passos expressed some ambivalence about curriculum fidelity. “As a good Las Palmas [district] principal, I should say you have to have fidelity [to the adopted reform curricula]. But in the pit of my stomach, I don’t really believe that. I think you have to have fidelity to the standards” (4/2/09). Ms. Passos rated herself an eight on a scale of one to ten in her knowledge of the CMP2 and Investigations curricula. “I have taught lessons when I had to cover for a teacher” (2/10/09). She was able to recognize which teachers were doing a CMP2 or Investigations lesson during walk-throughs. She also was able to quote information off of the CMP2 and Investigations websites. She was able to use that information in arguing that one program may not “hit all the areas.” In fact, the following quotes shows how Ms. Passos combined her understanding of the district’s guidance for a balanced mathematics program with her knowledge of the curriculum.

If you go to their website it says that prior to using CMP it is expected that the kids have a broad base in numbers and operations before they start CMP. So the expectation is that they already have those skills firmly in place, which may not be the case. And the second thing is, like the triangle that [the math coordinator] gave us, it does have to be balanced math so we have to make sure, whether the program provides it or not, that we are hitting all those areas. (Focus Interview, 2/11/09).

She believed that CMP2 and Investigations were excellent curricula in the hands of a good teacher, “There are materials that are in better alignment with your standards-based system than others, but I haven’t seen anything that 100% fills all the holes” (Interview, 2/10/09). Yet in the same interview, she stated,

You know what the deficiency is [when implementation isn’t successful]? They’re not playing those games. They’re ignoring the games and the games are what they [the trainers] said are going to teach the basic math facts and give students that reinforcement and our teachers are not doing it. (Interview 2/10/09)

So Ms. Passos supported full implementation of the Investigations and CMP2 curricula, but thought that they needed to be balanced with other materials to ensure students got computation, problem-solving and conceptual understanding.

She went on to say, “I know in my heart of hearts that if my lower grade teachers were better at Investigations, it wouldn’t seem like such a difficult transition to CMP” (Interview, 2/10/09). And she recognized that leading teachers to this end would require support. Throughout the implementation phase, Ms. Passos identified a need for “a strong district curriculum influence” in sustaining the momentum for the reforms because “there are still enough teachers that aren’t comfortable with it and complain. But for some

teachers, doing the curriculum by the book would be a huge step in the right direction” (6/2/09).

**Assessment and data.** “All teaching decisions really need to be driven by data – all kinds of data. It can be student work, observations, test scores” (Interview, 9/12/08). In fact, she was concerned that so much emphasis was placed on the MAP assessments. “Is MAP really the correct assessment? Is it aligned with the standards, with what we want to do?” (Focus Interview, 2/11/09). And at the end of that school year (4/2/09), she articulated even more clearly that,

We should know what students know and don’t know even before they take the test. And what’s important is what we do with that information. It’s only formative if we do something with the information. Assessment should keep the focus on student learning, not on the teaching. We need formative assessments and tiered interventions designed and supported by the whole school (Interview, 4/2/09).

The concern for student performance on the state mandated assessment was not just an accountability concern. Ms. Passos was aware that the assessment is standards-based and that a large focus of the SBA was on reasoning and communication in mathematics. She was concerned that Camino students had “flatlined” in mathematics on the state assessment because they were not getting the concepts.

To really address individual students’ conceptual understandings, her goal had been to have teachers construct their own assessments as grade-level teams, basing the questions on the state power standards for mathematics and on the curriculum. With this in mind, she developed mathematics “data-driven decision-making” guidelines for teacher Professional

Development Plans (PDPs), which were required as part of the annual teacher evaluation process.

The teacher can pick either reading or math and focus on one student all year. If they pick math, I want to know that they actually analyze student work to drive instruction. How can their routines and instructional materials help? I am asking them to explain what they had the student do, the reason. Then they examine and analyze student work and thinking. From there, I want to see their next teaching step. (Interview, 9/2/09)

As it turned out, Ms. Passos had some significant “push back” from teachers on this PDP requirement. They expressed concern about the burden it would require to keep such intense documentation on analysis of student work. This had not been asked of them before. Teachers came to her with many questions and complaints, and finally as a group they complained loudly enough that Ms. Passos changed the “requirement” into a choice. In an interview at the end of that year, Ms. Passos read several of the PDPs related to mathematics teaching and learning; however, none of them actually analyzed or examined student work or thinking. Rather they were about the teacher’s participation in a professional development opportunity called Lesson Study. Here was another instance where the social context of the school challenged her systems thinking about connecting mathematics instruction, assessment of student work and teachers’ professional growth.

**Opportunity to learn.** Although she was principal at a school where the Hispanic students made AYP each year, she acknowledged, “We still have a long way to go.” In 2008, only 31% of Hispanic students at Camino Real were proficient in mathematics. While she complained that her teachers ‘do not feel the urgency to improve mathematics

teaching.” Ms Passos felt this urgency strongly. She had spent six years teaching and two years as assistant principal at Tomasita, a school with a large number of Hispanic ELL students living below the poverty line. She concluded during her time there that the ELL students were often the best students. “They may not have spoken English in the home. They may not have even had beds to sleep on, but they always came to school clean and with their homework complete” (Interview, 11/15/07). When asked about the “opportunity gap” that was reflected in scores of the predominantly lower income Hispanic schools, she replied, “It’s not about whether they speak Spanish or English. It’s not even about poverty. It’s about drugs. Kids whose parents are into meth and other drugs don’t make the time to read to them or help them with their math” (Interview, 2/9/09). For Ms. Passos, the gap was any child who was only at beginning steps toward proficiency. She seemed to look beyond the “gap” to individual students, pushing teachers to find interventions to meet the needs of struggling students. This, too, was a challenge to the traditional culture of Camino Real.

Historically, Camino Real was considered a good school, even “up on a pedestal” (Mr. Torres, 6/2/09) because its students made AYP every year since the beginning of the NCLB accountability mandates. While they may not have faced the same challenges as Tomasita or Sands, 64% of Camino Real students were Hispanic, and 65% qualified for free and reduced lunch. The school has made AYP each year, yet only 31% of Hispanic students were at or above proficiency in mathematics, 9% below Caucasian students at the school. And while they did not have enough ELL students to form an accountability “subgroup” (NCLB, 2001), those ten or twelve students performed far below the other cohorts, with only 14% meeting proficiency in mathematics.

When I asked Ms. Passos about opportunities for all students, and why there might be such discrepancies, she articulated a belief that the reason was more about good teaching than about the backgrounds or language skills of the students. “Meeting their cultural and language needs depends on the teacher. Creating opportunities for all kids to learn mathematics in a classroom depends on how comfortable the teacher is with mathematics” (4-2-09). Put another way, “a good teacher is a good teacher for any child. If you know mathematics, and can teach mathematics, you can differentiate.” She gave an example of a teacher whose ELL students had over 51% proficiency, students in classrooms where the teacher provided interventions and extra time “for Sara to cross the line.”

Ms. Passos was very focused on pedagogy, including formative assessment that met the needs of every student, “regardless of his or her background or language” (4/2/09). In this way, she focused less on the “gap” and more on the individual student. She understood “the challenges students come with and why not all kids start on the same start line” (Classroom Observation, 4/3/09).

Some start on line [grade level], some in front, some behind. Depending on the school you’re at, you may have a whole bunch of kids who are behind the line. What would it look like, honestly, if you truly believed with all your heart that every kid can learn, or that you wouldn’t take no for an answer? What would it look like? What would that change in your organization? It should not be up to the individual teacher to come up with all the interventions. It should be up to grade-level teams. (Conversation, 4/3/09)

She also believed that the content language of mathematics challenged her ELL students and her students who had less exposure to mathematics language in English or Spanish.

None of our ELL students are mono-lingual Spanish speakers. I see it more as an issue of content language. Math has very specific vocabulary in English and Spanish. For example, on the SBA, there was a question asking students to “draw a table” to represent some data. You wouldn’t believe how many coffee tables and kitchen tables kids drew! So part of it is the language of the test. (Interview, 4/2/09)

She believed it was the teacher’s role to model and support students to develop the academic language of mathematics. “[A good teacher] is able to model the correct mathematical language, like giving the word *arrays* when the students were using “lines” and “rows.” But the ability to do that implies that the teacher has her own mathematical language and understandings. “You have to provide good training for your teachers because I know tons of teachers who are fluent in Spanish, but they aren’t comfortable in math in any language!” (Interview, 4/2/09)

**Making Sense of Policy and Accountability Representations.** District policies and expectations related to the mathematics reforms were of mixed value for Ms. Passos in her efforts to improve teaching and learning of mathematics. On the one hand, she saw how accountability created a sense of urgency in a school where teachers had become “complacent” and reluctant to change their mathematics pedagogy. On the other hand, some of the policies interfered with her ability to influence instructional change.

According to Ms. Passos, Camino Real had not felt the press for accountability. They made AYP each year, although in 2008, they only met AYP in mathematics because

they just made the lower confidence interval. When the superintendent came to the school in 2007 to challenge them to bring more students to proficiency, the staff was angered and “is still mad at him because they took it as an insult” (Interview, 9/2/08). She found it very challenging to make the demands for improvement that would require teachers to change their practice because they would say, “Why do we have to change what’s working?” So she believed that the accountability system could create a sense of urgency as well as a false sense of security. Teachers felt that making AYP was proof that their teaching strategies were successful (false security), while had they not met AYP, the same system would have inspired a sense of urgency as a catalyst for change.

The district policy requiring principals to do classroom walk-throughs every week only added to teacher resentment at Camino Real, and Ms. Passos believed it interfered with her ability to improve the learning culture. “I guess it depends on what your leadership style is. Here, it ruined me. Teachers didn’t like what was on their walk-through cards, and that caused me all sorts of political issues” (Focus Interview, 6/2/09). Her walk-through checklists were, in fact, more complete than those of Mr. Torres or Ms. Rojas. She noted which aspects of the balanced mathematics she observed, and always left comments. While such comments served to encourage questions and conversation between Mr. Torres and his teachers, they drove a wedge between Ms. Passos and many on her staff. “Walk-throughs weren’t getting us where we needed to go. They don’t work with my system” (Focus Interview, 6/2/09). She would have preferred more of a coaching role with teachers, yet felt that her supervisory position made the walk-through visits seem evaluative, and felt threatening to teachers, most of whom had been at the school a very long time. She indicated that they were also weak in mathematics and were intimidated by the reforms.



Realizing the negativity aroused by walk-throughs, she decided to “boycott” (her term) the policy. What she felt would work more systemically was building culture where “it’s not single teachers any more. Teaching and learning is a grade level responsibility, and you have transparency so teachers have to share their practices” (Interview, 4/2/09). Her systemic vision was to lead through grade-level professional learning communities that focus on mathematics teaching and learning.

The district decision to adopt a single K-5 curriculum and a single 6-8 curriculum was one she supported to promote improvement in teaching and learning, although, like Mr. Torres, she did not seek 100% fidelity. She believed the district’s focus on professional development and training for teachers in the new curricula had the real goal of changing the practices of the most “traditional” teachers. Ms. Passos saw the emphasis on reform to be “to help older teachers convert to a constructivist point of view of math versus the rote so the district concentrated professional development on the investigative approach because they knew it would be the least comfortable for those teachers” (Interview, 5/29/08).

**Conceptions of Leadership and Adult Learning.** While Mr. Torres emphasized data-driven decision making as the focus for improving teacher pedagogy, Ms. Passos hoped to improve teaching and learning through teacher involvement in professional learning communities where teachers’ work became shared and public. The role Ms. Passos would have preferred was one of prompting teams of teachers to critique their teaching and learning of mathematics. When she was assistant principal at Tomasita, she conducted mathematics workshops for teachers, including sessions about how to use math journals to encourage students to communicate their mathematical thinking. But at Camino Real, the “political atmosphere” was resistant to change, and she found over the two years of this

study that the most important consideration was “providing a safe environment where teachers can learn, leaving the collaborative work with teachers up to my academic coach” (Focus Interview, 2/11/09). She came to feel that as principal, teachers saw her as an evaluator, not as a coach. She lamented that she had to be the “supervisor” and leave the coaching to her academic coach, who was only half time. “It is a trust issue. I think the teachers feel safer collaborating with the coach, without me there. I need to protect the coach’s role so it is never supervisory” (Interview, 9/10/08). She also stated that much of her time was taken up in “dealing with parent issues, management concerns and political issues with the mayor and a board member” (Interview, 2/11/09). Therefore, her next line of support was PLCs, which she realized would take time to build.

That grade level team is really important because that's where you're supporting each other. You're sharing our data. You're saying, 'I have this many kids who didn't get this concept.' They can learn from other teachers. It becomes a professional learning community instead of just one lone teacher trying to brave it. (Interview, 4/2/09)

Being a principal is not about being an instructional leader. It's about being a learning leader, providing an environment where teachers can learn. That sometimes means letting the AC [academic coach] do the coaching work” (Interview, 2/11/09).

Half way through the second year, Ms. Passos attended a conference on PLCs. She came back with a renewed belief that she had to be part of the collaborative learning, and even guide the team if necessary. “If we used the time we have spent doing walkthroughs attending our PLCs instead, think what a difference we could make!” (3/11/09 ). She was interested in improving teaching practices at scale, and believed that PLCs provided both

the safety of a community and the press to reflect on one's practice. She also believed that once teachers understood the need to improve or change their pedagogy, they needed the ongoing support of more knowledgeable others – either peers or the academic coach. She felt that both her academic coach and her IEP coordinator were strong in mathematics teaching and learning, and recognized the need to give them the responsibility to lead teacher learning. However, she also felt that teachers felt threatened by her presence as an “evaluator”, and thus she did not attend many PLCs.

Like Mr. Torres, she supported her teachers' professional learning. She had two teams involved in mathematics Lesson Study. She covered classes for teachers so they could attend training, and she encouraged teachers to seek their own professional learning opportunities. “My sixth grade teachers had much more training than my Investigations teachers. They sought out training and took all the training they could find” (Interview, 4/2/09). She lamented the fact that her coach, who she felt was effective, was only assigned a half-time position at Camino Real, so was rarely available to support teachers in the classroom.

A major focus toward which she had begun to guide the work of teachers was looking collaboratively at student work. Realizing she had to move slowly and that asking teachers to bring their own student work might be intimidating, she began in the middle of the second year of implementation of the reform curricula with a staff meeting where every teacher, grades K-6, looked at a mathematics “release item”<sup>1</sup> from a previous standards-based assessment. Then she gave teachers samples of four student responses and had them

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<sup>1</sup> Each year, the state releases several questions, including constructed response questions, from previous-years' standards based assessments, to be used for both analyzing student errors and for informing instruction.

score the work using rubrics. The problem had to do with reading a data chart and then putting the data into a graph. The student then had to make a prediction. Ms. Passos said teachers became very engaged, especially looking at how graphs were labeled and what predictions students made. She saw this as a beginning to moving teachers toward looking together at their own students' work. Verbs in her interviews included "move teachers" or "guide teachers" to become more collaborative, to make their teaching more transparent.

Ms. Passos referred to other ways she guides teachers. She became concerned when her fifth graders performed poorly on both the MAP assessments and the SBA.

I found out in a round-about way that last year, some teachers weren't teaching math every day! So I brought it up in a staff meeting, trying to be diplomatic, by saying that certain teachers were sacrificing math time and not teaching math every day due to scheduling conflicts. I guided them to the conclusion that our school goal would be daily small group instruction in reading *and* math. So now the time is at least sixty minutes. It's a bare minimum. We know it should be ninety, but teachers still use scheduling as an excuse (Interview, 9/10/08).

Ms. Passos had very clear ideas about the challenges that the mathematics curriculum reform had meant for teachers. She also understood that those challenges, combined with a sense of complacency resulting from meeting AYP, had lead teachers at her school to "try to get away with" or justify their lack of fidelity to the curriculum and the pedagogical reforms. Her goal was to promote a collaborative learning community that would provide incentives for teachers to take risks and learn best practices from one another. "We can't just settle for the coaches to meet and tell us what's important in the curriculum. We can't have just a curriculum do it. We can't have the superintendent of

curriculum do it” (Interview, 5/29/08). She wanted her role to be to lead those learning communities, based on research, and to inspire teachers to develop the content knowledge for teaching the new curricula. She admitted her challenge was finding the right balance of press to hold teachers accountable for being learners and for implementing new practices.

I am one of those people who kind of relishes the academic leader kind of role, but I feel because we do have to play more of the day to day policeman. Police it - are we doing it, are we seeing it, which is a little bit awkward for how *I would like things to run*, but it's the role you have to play because you really do need those coaches to be the good guy (Interview, 5/29/08).

Like Mr. Torres, Ms. Passos relied on the district-mandated professional development to train teachers in the implementation of the reform curricula. While she enthusiastically encouraged teachers to find their own professional development opportunities, she did not talk about a desire or a need to provide school-wide training at the school site for either the curriculum or the pedagogy.

**Summary: Conceptions of Leading Mathematics Reform Initiatives.**

*Setting direction.* For Ms. Passos, leadership for mathematics reform meant leadership for improving teaching and learning through systems change. If she could have waived the tenure policies and create vacancies, her primary leadership role would have been to “have the opportunity to screen and filter and hire the best teachers that I could. That’s number one” (5/29/08). But at her school, there were few opportunities to hire new teachers because the staff was very stable. So she looked at ways to develop the skills of the teachers she had. She was clear about the challenges she faced. She did not see herself as a charismatic leader, “swooping in and curing everything just so the next principal can do

something different” (Focus Interview, 2/11/09). She also recognized she could not set direction by force. Two years into the curriculum adoption, she stated,

I don’t feel like my personality is strong enough to force people to do things. You can force people into groups but you can’t make people be collaborative. You work with the ones that are ready and hope modeling by others will move them. My philosophy is that I need to empower teachers to run their own school. (Interview, 4/2/09).

To improve mathematics teaching and learning, Ms. Passos determined she needed to focus on three areas: teaching to the standards; promoting professional collaboration to achieve greater transparency in teaching; and using data to attend to the learning needs of every student. As a “systems person,” Ms. Passos saw a greater need to connect mathematics teaching and curricular reforms to the standards. With clearly delineated state standards to which the SBA was aligned, and with a district standards-based report card, Ms. Passos felt there was sufficient district focus on the standards so that her own efforts would be supported. She modeled this focus by asking teachers to always have a standard posted for their mathematics lesson and to share it with the students. She noted this on her walk-throughs. She made standards the central topic of staff meetings. And she expected teachers to drill into the data from SBA and MAP assessments to learn which standards were weak points. Her belief was that the standards represented what students should know and be able to do mathematically. Yet she held reservations that “no curriculum can cover it all, 100%” (Interview, 4/2/09).

A focus on standards also influenced how she expected teachers to use data. She looked critically at the MAP and SBA assessments because they weren’t always the best

indicators of whether a student knew the mathematics. “I’ve learned that MAP is not such a good indicator for ELL students. One girl got a 2% on MAP scores, but other assessments in Spanish showed she was at 95% proficiency” (3/11/09). She wanted her teachers to learn to look at the MAP assessment as one piece of data, but also to look at classroom formative assessment as a critical piece. She set a direction for analyzing a broader set of data to inform instruction and to target individual student interventions.

In terms of setting the direction for curriculum fidelity, Ms. Passos was more familiar with the reform curricula than the other participants. She had spent time teaching students. When I accompanied her on classroom walk-throughs, she was able to identify Investigations and CMP materials. She believed that full implementation was the goal, the direction to set. But she also felt there might be gaps in the curricula that teachers needed to supplement. Therefore, in the two years of this project, she did not look for full implementation. “Three days a week doing Investigations” for a teacher whose students were nearing proficiency was fine with Ms. Passos.

*Developing people.* Ms. Passos conceptions about her role as a “learning leader” dominated her comments. She was both excited about the possibilities of leading a collaborative learning process to discover ways to improve mathematics teaching and learning, and frustrated by teacher resistance. For these reasons, she revealed mixed feelings about her role in holding teachers accountable for the reforms, both those suggested by district policy and those that stemmed from her own beliefs about teaching and learning. While she felt some teachers needed the pressure of the walk-throughs to push them to try new things, for the most part “press has backfired on me. I have a hard time with the press. I always said I would prefer to inspire than to force” (Interview, 4/2/09). The kind of

supervision practiced in walk-throughs and through presenting teachers with their MAP data felt to Ms. Passos like “policing.” School social context and traditions, old habits and beliefs, and what Ms. Passos termed “complacency” born of making AYP made it difficult for her to influence systemic change through supervisory press.

***Redesigning the organization.*** In order to support a focus on standards-based teaching and collaborative learning communities, Ms. Passos realized that she needed to address the learning culture of the school. She devoted considerable thought and effort to building PLCs where teachers felt safe, and that were focused on instructional improvement. She felt that the culture of isolation and “superficial niceties” detracted from her vision of a learning community where teachers came together as learners to improve their practice. “The goal is transparency. If you don't have single teachers teaching anymore, if you make it a culture that it's grade levels who are responsible, then that's where the transparency comes in” (Conversation, 3/11/09). There was already a schedule that provided weekly collaboration for teachers at Camino Real, but teachers saw those collaborations as a choice. Ms. Passos redesigned the accountability system so that teachers were expected to attend and the academic coach facilitated the meetings. Other redesign efforts included reassigning teachers to other grade levels where she felt they “could do less damage” and creating a team to explore the development of a dual language program.

The dominant theme in Ms. Passos interviews was building systems to support student learning. She had strong content knowledge for leading mathematics reform; she had researched best practices in constructivist teaching, and she appreciated that knowing students' mathematical understandings meant assessing more than three times a year. Because she believed that mathematics reform was challenging for most teachers, she saw



her current role as walking a delicate line between support, guidance and press. After receiving backlash from some of her attempts to hold teachers accountable, as in the walk-throughs, she decided to take a more gradual approach to leading change. The introduction of the practice of teachers looking together at student work, using the SBA samples, was a way to introduce them to the practice while staying in their comfort zone. She admired Mr. Torres' ability to press for teachers to improve. She recognized that other principals had skills that would add to her ability to improve teaching practice. "Mr. Torres and I have different skill sets, but we each have different strengths, and together we would make one excellent principal!" (Interview, 2/9/09).

<b>Ms. Passos' Conceptions of Leadership for Mathematics Reform</b>	
<p><b>LCK:</b></p> <ul style="list-style-type: none"> <li>• Mathematics</li> <li>• Teach/Learn</li> <li>• Curriculum</li> <li>• Assessment</li> <li>• Adult Learners</li> </ul>	<ul style="list-style-type: none"> <li>• Strong agency with mathematics</li> <li>• Familiar with curriculum, but ambivalent about 100% fidelity</li> <li>• Looked at student conceptions/misconceptions during classroom visits</li> <li>• Saw equity in mathematics classroom mostly as issue of meeting individual student learning needs</li> <li>• No attention to ELL subgroup - numbers too small to affect AYP status.</li> <li>• Conceived of leading teachers to learn more ongoing formative assessment for each student</li> <li>• Wasn't sure how to press teachers who are resistant to change</li> <li>• Realized the challenges mathematics reform holds for adult learners – but no organized effort for PD</li> </ul>
<b>Policy</b>	<ul style="list-style-type: none"> <li>• Saw role to push teachers to look beyond short-cycle assessment data, to include classroom assessments and student work.</li> <li>• Got strong push-back from teachers on supervision "walk-through" policy.</li> <li>• Found "meeting AYP" removed incentive for teachers to change practice</li> </ul>
<b>School Context</b>	<ul style="list-style-type: none"> <li>• Perceived her role must be sensitive to teachers' fear of change and risk taking (approach looking at student work in mathematics using anonymous student sample from Public Education Department website)</li> <li>• Perceived political pressures.</li> <li>• Believed strongly in PLCs but did not attend, feeling teachers intimidated. Only at end of study spoke of need to attend to take role in setting direction.</li> </ul>

**Ms. Rojas – “Looking for the Silver Bullet”**

**School context.** Out beyond Tomasita, on a mesa of sage and tumbleweeds, lies Sands Elementary. It was by all accounts the most challenging elementary school in the district (Ms. Sands, Mr. Torres, Ms. Passos, Math Coordinator, District director of Research and Accountability). The students had not made AYP since NCLB began the accountability measures in 2002, and it was currently designated a “Restructuring 2 (R2)<sup>2</sup> school by the state accountability system. This meant that they are supposed to be under scrutiny by the Public Education Department, but, in the words of Ms. Rojas, “We’ve had one visit from a PED person in the past year. They leave us alone out here” (Interview, 4/3/09).

As with Tomasita, Sands’ students arrived with parents or by bus. Due to the district re-organization, Sands had also recently changed from an “intermediate school”, serving fifth and sixth graders, to a kindergarten through sixth grade with 500 students, which added new challenges and opportunities. Eighty-five percent of the students lived in extreme poverty. The school Free and Reduced Lunch rate was 100%. Also, Sands served the largest percentage of Hispanic students, the largest percentage of ELL students, and the largest percentage of poor students in a district that is already above the state average in all those areas (U.S. Census, 2000).

On a cold February morning, I drove with Ms. Rojas through the community of Las Maravillas, whose children comprise the majority of Sands’ enrollment. It was a touching and sobering ride, one she had done with her teachers on a hired bus the year before. “This

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<sup>2</sup> The R2 designation is assigned to schools that have not made AYP for five consecutive years. For R2 schools, districts must develop an “alternative governance” arrangement for the school, consistent with state law. The plans range from replacing all or most of the school staff, including the principal to state take-over to close the school and re-open it with new structures in place (NCLB, 2002).

school serves ‘the war zone’” (Conversation, 12/2/08), meaning that there was a high incidence of drug use, meth labs, and crime. Las Maravillas has no street signs, no house numbers, and mostly dirt roads. Ms. Rojas stated, “Home visits are challenging because we don’t know how to find the addresses.” Most of the homes are trailers, some with jerry-rigged stovepipes protruding from a window to provide heat. Several lots evidenced recent tragedy with burned out trailers, the result of unconventional heating or meth labs (Ms. Rojas, 12/2/08). Many of the front yards were home to a goat, a cow, or a pit bull, which shared space with rusted shells of old cars and appliances. Water was available through a county well, but many homes had no running water or electricity (information from phone conversation with county utility employee, 12/4/08). I recalled my visit to a colonia outside Juarez, Mexico. Clearly the families living in these homes faced many challenges.

The student body at Sands was 82% Hispanic. Sixty percent were English language learners whose families were from Mexico. According to Ms. Rojas, there were not many recent arrivals, but families came and went between the U.S. and Mexico, causing a high student body “rotation” of the same families.

In addition to the challenges the school faced demographically, there was also a high staff turnover. Within the two years of this research project, Ms. Rojas had almost two thirds of her staff turnover, and that had nothing to do with district restructuring. “Our teachers have to work twice as hard if we want to catch these kids up. Plus, who wants to come way out here. It’s hard to find and keep teachers here” (Interviews, 9/12/07 and 4/3/09). There is also minimal parental involvement in the academic program. When I asked Ms. Rojas about parents coming to the school, she said, “We have a couple who came to paint the cafeteria and we had quite a few at the Christmas pageant” (Conversation, 4/3/09).

To attempt to meet the needs of the over 250 English Language Learners that attended Sands, Ms. Rojas ensured there was a bilingually certified teacher at every grade. This meant that not all ELL students were placed in a class with a bilingually certified teacher, because there were too many. In addition, they had received little guidance on the design of their “dual language” program, so the language of instruction ranged from “one week in English, one week in Spanish” to “one semester in English, one semester in Spanish” (Interview 12/2/08). The scheduling of those classes “causes problems for us because if a lot of kids leave [a dual language class] not just any kid can come in” (Interview, 4/2/09).

The infrastructure that existed to support mathematics teaching and learning was designed to promote and accommodate two major goals at the school. The first was the goal of giving students more time to study mathematics and literacy. “They need more time to make up for the fact that they enter school a year to two years below grade level” (interview, 4/3/09). There was after school tutoring in place for all students who were at beginning levels of mathematics and reading, and a summer intervention program. The second goal was teacher collaboration and professional development. Ms. Rojas had created a schedule that gave teachers time to collaborate “every day, if they want to,” the expectation being at least once a week. Using Title I money, Ms. Rojas hired a second P.E. coach, giving teachers at each grade level back-to-back “specials” like P.E. and music to give them planning time.

A key to understanding Ms. Rojas’ conceptions of leading mathematics reform and her sense-making about the school context at Sands was the story of her efforts to change the school calendar. The purpose and vision for this change was to give students fewer long

breaks away from instruction and opportunities for “intersession” tutorials. Ms. Rojas, mostly on her own volition due to such high staff turnover, fought heroically for year-round school for Sands students for three years. Her proposals to the superintendent and the board of education outlined the importance of shorter spans of time away from school and more time for instruction. Finally, in the spring of 2009, the school board granted her request, only to withdraw it in June, when the budget shortfall hit. Two ideas from this story are important to this study. First, Ms. Rojas believed strongly that students needed more time at school, and “less of a summer learning gap by not having those big breaks where they’re at home and just speaking the language and just having the environment that they do” (Interview, 4/2/09). Second, she spent large amounts of time on this leadership project, which was focused on an intervention to give students more time at school. This left her little time to be involved in the actual mathematics teaching and learning needed to make the pedagogy and curriculum more effective.

**Ms. Rojas’ Mathematical History.** Ms. Rojas, an Anglo from the mid-west, was a veteran principal. She had been an educator for thirty-two years. She began her career in Indiana, where she taught elementary grades and then became director of a developmental infant and preschool program. She led that program for thirteen years. Twenty years ago, she moved to the Las Palmas district where she started as an itinerant Special Education teacher and then worked as an Individual Education Plan (IEP) facilitator. In 1995, she became a principal, opening a school in the Las Palmas district. In 2000, she was asked to open Sands, which was built on the east mesa, out of the town limits.

Important to understanding her mathematics leadership conceptions was the fact that she never taught mathematics in a traditional education classroom. Her experience was in

early childhood and special education. In fact, her mathematics history was limited. She expressed a lack of confidence in mathematics when she described herself as “that kid in the back of the room that couldn’t see how math applied to anything” (Interview 9/12/07). However, her leadership experience was considerable. As a principal, she had opened two schools (newly constructed at the time), and had supervised pre-school through sixth grade instruction.

### **Ms. Rojas’ Conceptions of the Substance of the Reforms.**

*The subject of mathematics.* Although she did not feel confident in her own mathematics background, in our focus interviews that included “doing mathematics” or observing videos of classroom practice, Ms. Rojas was curious, engaged, if slightly hesitant about offering her answers. In a focus interview, I gave the principals the vignette about a teacher giving her class the problem  $39/5$  and one child turned it around to “You can’t divide 5 by 39.” The teacher decided to explore that student’s idea. Ms. Rojas liked this “tricky problem” and the idea of following the thinking of the students. She saw that the teacher’s questioning strategies were leading students to think about division as fractions. In fact, of the three principals involved in the discussion, she was the only one to follow the teacher’s line of questioning. Throughout the two years of her participation in this study, she expressed an appreciation for engaging problems that allowed the learner to work with complex mathematical ideas.

However, while appreciating rich mathematical problems and discussions that engaged students, Ms. Rojas also revealed a more instrumentalist philosophy of mathematics as a subject. She believed that knowing mathematics required knowing some basic facts first. “How can they solve the problem if they don’t even know how many inches

in a foot? Even third graders should know that!” She indicated a belief in “one right answer” when helping a kindergartner with a pattern sequence. He had been trying to figure out the next letters in the sequence AABAAB. When he wrote BAA, Ms. Rojas said, “No, listen, AAB, AAB,” emphasizing the sound of the pattern.

Ms. Rojas indicated that she was struggling with her own philosophy of mathematics as a subject, a struggle that caused her to question pedagogical moves and curriculum implementation. In a focus interview, she asked other principals to help her resolve a dilemma.

Should teachers stay at one thing, like multiplication facts, until they know them?

Teachers say, ‘I haven’t been able to do anything else besides teach multiplication facts, and they still don’t know them!’ And I say, ‘You need to keep going with the curriculum.’ But if they don’t know it, don’t they need to re-teach? (6/2/09).

***Teaching and learning mathematics.*** Ms. Rojas is the principal in the vignette that introduced this dissertation. She wrestled with how to support teachers in mathematics because she had little experience herself with teaching mathematics, and she was not familiar with the reform curricula. Yet she had some very specific ideas about what should happen in the mathematics classroom to engage students. The following example came from the observation of a Lesson Study implementation. It serves to highlight Ms. Rojas’ ideas and beliefs about teaching and learning, and how her own mathematical understandings limited her ability to see the issues that were problematic in a fifth grade lesson.

The lesson we observed was the “teach” component of a particular mathematics Lesson Study. The lesson was Sammy Snail (see appendix F). The mathematical ‘big idea’ of the problem was one of ratio – two to one. Sammy was trying to get up a 30-foot wall.

He crawled up three feet in the day and slid back eighteen inches at night. The teacher had materials for the students to measure inches and feet. Because she saw it as a measurement problem, she guided them to convert the three feet to inches and then work with inches, rather than try to calculate in both feet and inches. The students struggled for a long time trying to get to thirty feet. One group finally began to see the up two, down one ratio just as the lesson was finishing. Later, when I asked Ms. Rojas what she thought of the lesson, it was clear that she listened to students thinking, but she, also, did not see the mathematical big idea. She addressed two concerns. First, she was concerned about the fact that so many fifth graders did not know how to convert feet to inches.

I thought the kids' performance was pathetic. I was disappointed because the kids didn't even have basic knowledge needed to do the lesson. These kids are in fifth grade and they don't even know twelve inches equals one foot! I was just in a third grade room and they knew how, and here are kids two years later who forgot!

Second, she noted that the teacher should have stopped the lesson when she saw many of the students were confused. "If I was teaching, I would have stopped and said, 'wait a minute, let's back up. Let's go over these basic facts and then go on to the lesson.' She should have re-taught inches and feet" (12/2/08). So Ms. Rojas focused on the mathematical facts rather than the bigger concept of ratio, indicating she did not grasp the bigger mathematical idea of the lesson. Thus, she did not appreciate that the teacher had not understood the big mathematical idea. In our conversation after the observation, she was interested to hear that the problem was one of ratio, and she was distressed to learn that "this teacher knows her math but apparently she was using the wrong lesson to teach measurement and probably confused the students."



In the lesson, when students became stuck trying to convert feet to inches, she felt the teacher should have done more to support the students' thinking by activating prior knowledge about measurement and reviewing. She resorted to her beliefs and knowledge about general teaching strategies to critique the lesson.

I like to see teachers' ability to ask the right questions to get kids to get them thinking for themselves. Not just showing them how to do it or giving them the answer, but really being able to provide that guidance for them to actually investigate and learn. Before the lesson there needs to be pre-teaching for any new concept, and it has to be shown visually (Conversation, 4/3/09).

This observation episode highlighted other teaching and learning beliefs for Ms. Rojas, as well. She stated that she looked for mathematics lessons that were engaging and relevant for all students, the use of manipulatives, and teaching that activated students' prior knowledge. She also expected teachers to use mathematics vocabulary, specifically vocabulary from "several states' standards based assessments" which she found on-line. She made grade level copies for all teachers and even for the librarian and the coach so everyone could be modeling the words.

While Ms. Rojas tended toward a more problem-solving inquiry approach to teaching and learning, she admitted that she did not know the curriculum, and she described herself as having a weak background in mathematics. This limited her ability to see beyond the surface layers of the teaching and learning. Consequently, she relied on teachers' concerns to influence her beliefs about curriculum, scheduling, and pedagogy. "Our Educational Plan for Student success says we need 75 minutes for teaching math, but teachers say that doesn't work with the schedule" (6/4/08). "They say kids don't learn their

facts with Investigations” (6/4/08). Because Ms. Rojas was struggling with her own philosophy of mathematics as a subject, teacher input and policy messages about curriculum implementation caused her to question pedagogical moves and curriculum implementation.

***Curriculum leadership.*** From the first interview in the fall of 2007 until the last interview in the spring of 2009, Ms. Rojas continued to express her lack of knowledge about the mathematics curricula.

I know I don't know Investigations. That's why it was so important for me to get an academic coach for math that knows the program and knows how to work with the program to fill the gaps. I haven't been involved and practicing it, and you have to be practicing your craft if you're going to do it (Interview, 4/3/09).

When asked how many of her teachers were teaching with the new curriculum, she suggested I ask her mathematics coach because “I sure wouldn't know” (4/3/09). According to the coach, only about 30% of the teachers were attempting to fully implement the program (4/3/09).

In spite of her lack of familiarity with the curriculum, Ms. Rojas supported the district adoption. “Investigations and CMP are the district's adopted programs. They are expected to be used” (6/12/08). She used the district promise that representatives would be out to visit classrooms as press to urge teachers to implement the programs. She envisioned full implementation in every classroom, stating, “Every year we need to build on the curriculum. Everyone will do it next year. I'm pushing consistency” (4/3/09). She felt that teachers who taught the summer intervention program should be asked to use Investigations, because “If they don't already use it, they're not comfortable with it, and they will become more comfortable as they practice” (Interview, 4/3/09). This statement reflected a belief that

teachers could develop the pedagogy and come to know the intended curricular goals by implementing them, a belief researchers have found problematic yet prevalent in studies of curriculum implementation (Manouchehri & Goodman, 1998; Remillard, 2005). Ms. Rojas had not conceived of the intricate and substantial supports teachers would need to develop the new content knowledge for teaching. And her own lack of familiarity with the curricula meant she was not able to assess the enactment of the curricula as intended.

Perhaps because she was not familiar with the CMP2 and Investigations curricula, Ms. Rojas listened to her teachers' thoughts and concerns. She echoed their complaints about how difficult the programs were to use. "Teachers say it takes too much time to make materials and copies (Interview, 4/3/08)". She was concerned because "The teachers say Investigations doesn't align with the standards. For example 'predictions' is on the third grade SBA but not in Investigations" (Interview, 6/12/09). And she was convinced that the curricula had gaps. "Teachers have said that because they had training in Dots and Grids and the other program, it has filled in gaps in Investigations" (Interview, 4/3/09). In sum, it appears two issues contributed to her inability to fully support the adopted reform curricula. The first was her own lack of familiarity with them. The second was that she was influenced by her teachers' concerns – the very teachers to whom she attributed little skill in teaching mathematics. It is also likely that the district's introduction and support of supplementary programs like Dots and Grids and Number Literacy served to dilute the policy representation of a "mandated" curriculum. Because the district trained teachers in Dots and Grids and Number Literacy, and because those supplemental programs were easier for teachers to learn than the reform curricula, they felt they had "permission" to choose what they taught and when.

*Assessment and data.* Ms. Rojas' ideas and beliefs about assessment and data for improving mathematics teaching and learning took two tracks. The first track was assessing students to determine what interventions might be necessary. However, like for Ms. Passos, she had the long-term goal that teachers would come together to develop their own assessments. If the year-round calendar had been implemented, she envisioned that teachers would "have to make their own assessments" because the intersessions in which tutorials were offered did not fall in sync with the MAP assessments. "Creating our own assessments is the only way we will know who needs interventions" (4/2/09). The second track that drove Ms. Rojas' ideas about assessment was the district and state mandates for demonstrating significant improvement in the number of students proficient in mathematics. The school used MAP scores to determine which students needed mathematics interventions. Those interventions were "required" by both the district and the school, yet, as Ms. Rojas noted, "teachers are not always held accountable" (conversation, 9/8/08) for implementing the interventions.

Ms. Rojas knew how to present her teachers with all of their class data on the short cycle assessments. She encouraged her teachers to focus on improving mathematics proficiency for those students "who were right on the edge – who missed proficiency by one or two points. And to think that's what made this a failing school!" (Interview, 4/3/09). With this thrust, her students met AYP in mathematics for the 2009-2010 school year, due to the safe harbor provision.<sup>3</sup>

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<sup>3</sup> Safe harbor refers to schools that did not meet AYP targets, yet are assigned the "met AYP" determination because their subpopulations, like ELLs, made at least a ten-point gain.

The MAP assessment data was used at Sands to identify students who needed intervention in mathematics. Students who were only at beginning steps, in the first quartile, were placed in an after school “homework club” where teachers were available to help them with mathematics. “It gives them more time to learn and more support than they get at home” (9/7/08). The math coach had indicated that she believed “our teachers really need to become more aware of what their students know and don’t know related to classroom math instruction” (6/1/09). Ms. Rojas agreed, but wanted her coach to lead that effort.

***Opportunity to Learn.*** The drive through Las Maravillas with Ms. Rojas revealed her knowledge of and commitment to this school community. She knew the circumstances to which many of the Sands students returned home each day, and she devoted much of her leadership at Sands to creating alternative supports for students. Some of those supports included getting a grant to fund an after school tutoring program for reading and mathematics, and hiring a mathematics coach to help teachers develop interventions. All students who fell in the bottom quartile on the MAP assessment were placed in the intervention program. The main impetus behind her efforts for a year-round calendar was the belief that Sands students lost too much learning in the summer months away from school.

On a number of occasions, Ms. Rojas expressed her beliefs about the challenges students faced, and that her teachers needed to address. The challenges include language development, lack of parental support for academics, and poverty.

Learning correct Spanish, Correct English, and content language - it’s too much, especially without parents at home to help. Most are illiterate and only *speak* Spanish. They don't read it. (Interview, 12/7/08).

It's just a handful of parents that actually take the initiative to find out what the math program and homework is about or understand it better. The biggest portion are illiterate or don't speak English, so that's harder to deal with.

Our kids come in one to two years below all other schools, according to DIBELS (Dynamic Indicators of Basic Early Literacy Skills). (Interview, 4/3/09)

The out of school experiences that our kids have are very limited compared to the out of school experiences of the Anglo population, for the most part. By out of school experience, I mean parents take them to swimming lessons, piano lessons. It's a financial issue. I'm sure there are a lot of parents who would like that for their kids, but they just can't afford it. (Interview, 4/3/09)

I've told the teachers, when they complain about how the kids don't do their homework and don't take responsibility, I say, 'We can't expect that. All we can do is what we have control over here at school.' Expecting them to do homework knowing some of the homes that they go home to – they're in survival mode. (Interview, 4/3/09)

Ms. Rojas believed she could take a direct role in improving student proficiency in mathematics. In hopes of providing students with a greater opportunity for success both in the classroom and on the state standards based assessment, Ms. Rojas compiled notebooks of sample mathematics test items for each grade level.

Every day I had teachers send just one problem home with the kids. I sent a letter home to parents - told them that we were changing the homework policy and every night, or 4 nights a week the students would have one math problem that they had to do for homework, and that they were accountable for that. They had to turn that

math problem in, and if they didn't turn it in, if they didn't do it at home, they'd have to do it during recess. Scores went up in all subgroups in math. Kids were turning in homework that had never turned in homework before; teachers were getting 100% of their students to return homework. (Interview, 9/12/07)

One area Ms. Rojas felt they did "have control over at school" was making learning relevant for students. She spoke of a sixth grade classroom where she observed a teacher using baseball scores to teach mathematics. The students were engaged in the project, which lasted several months, and learned batting averages and points and tournament schedules.

If you can't relate things to real life for kids, then it just completely shuts them off. So I think the most basic thing is to show them how you can use math in every possible way that would make sense to a kid. We have to be able to tie it to their lives. (Interview 9/12/07)

She also spoke of the language challenge in a way that reflected her beliefs about academic language instruction. Speaking of the over 50% of her students who had Spanish as a home language, she suggested that those children did not have academic language in either Spanish or English. So, "in addition to learning academics, learning how to be in school, they're trying to learn Spanish and they're trying to learn English. When you add content on top of that, it's too much" (Interview, 4/3/09).

Significantly, Ms. Rojas acknowledged that most of the students matriculating to the middle school intervention program for mathematics, Ramp-Up, came from her school. She ascribed the concern to the quality of mathematics instruction, but indicated resignation.

Well, you know, I think, the majority of them (Ramp-Up students) are coming from my school. But I think it's just been that thing . . . what's been consistent is our

scores just keep going up and we're improving, but we haven't made it out as far as, "this will be done" the expectations that the teachers are going to have to follow— the consistency, the walk-about, the checking on each other. (Interview, 6/12/08)

Upon further probing, Ms. Rojas attributed the placement of ELL students in remedial mathematics as a symptom of two problems: the quality of mathematics instruction and poverty. She believed that the strongest teachers of mathematics had a core of mathematics skills as a foundation and were able to make mathematics relevant for their students. Yet she expressed deep concern that she could not get district support to hire and keep good teachers at her school.

A lot of elementary teachers just don't understand the math themselves. When I do find someone I like and who knows math to request, Human Resources offers them other schools as well. Of course they take it. Who wants to come way out here when they can work in town? (Interview 9/12/07)

Additionally, Ms. Rojas believed mathematics instruction at her school suffered because of high teacher turnover and because teachers currently at the school were not improving adequately. She thought hiring a mathematics coach would help her to address this.

Ms. Rojas also spoke of the challenges of "getting students in kindergarten who are already two years behind" (9/8/07) as a result of their home environment. She related having devoted considerable focus with staff on understanding poverty, using Ruby Payne's book (2003) as a basis for discussions. She hired a bus so they could ride together through the neighborhoods of the children they taught. Linking the two ideas, Ms. Rojas said she wanted teachers to relate their mathematics instruction more to students' lives.



**Making Sense of Policy and Accountability Representations.** Ms. Rojas, like the other participants, took the district data and accountability policies seriously and used MAP data to encourage teachers to improve instruction. She shared MAP scores with teachers and asked them to relay the results to their students. “It was so great to see kids come smiling down the hall saying, ‘Look, I went up ten points!’” (Conversation, 3/11/09). She talked about having her coach look at MAP data with the teachers, as well. Short-cycle assessment scores serve to punctuate Ms. Rojas’ assessment of teacher efficacy. In describing her concern about two sixth grade teachers, she commented, “all students had an approximate ten percent gain on MAP from fall 2007 to spring 2008, with the exception of the sixth grade, who went down!” (Interview, 2/7/08)

Highlighting the emphasis on district and state assessment data, the main hallway at Sands sported a wall of SBA data indicating slow but steady progress toward AYP. While they came in consistently below the other schools in the district in mathematics, data indicated that they were improving. But it was clear that while Ms. Rojas felt the onus of responsibility for presenting improved mathematics proficiency to the superintendent and the board, and she buffered her teachers from grappling with the implications of the data. “I took these graphs to the board,” and “I had to explain that data had been entered incorrectly” (Interview, 4/3/09).

Regarding the district policy on supervision, doing weekly walk-throughs of classrooms, Ms. Rojas was somewhat vague in her comments. She spoke very little of her own data from teacher observations, and suggested that her assistant principal did many of the walk-throughs. She did, however, develop a “walk-about” model where grade-level teams spent half a day observing in one another’s classrooms. The intention was that

teaching would become more transparent and that “teachers would look for things like student engagement – that was our big focus” (4/3/09). But because “teachers were critical of each other” and “That wasn’t the purpose of it,” the process did not last.

**Conceptions of Leadership and Adult Learning.** Ms. Rojas articulated three strong beliefs about what teachers needed to become successful in helping students to become proficient in mathematics. First, she believed that teachers themselves needed stronger knowledge of mathematics. To address this need, she encouraged her mathematics coach to hold early morning workshops to give teachers hands-on experience with the mathematics concepts they were teaching. Because these workshops were optional, and because the coach was learning the program as well, not many teachers attended. Therefore, Ms. Rojas continued to lament, “I have teachers who just don’t understand the math and don’t have the confidence to do it” (Interview, 6/2/09). This was coupled with high turnover, and the resulting large number of new teachers. She described these new teachers: “They’re like deer in the headlights and they’re not prepared to take on a program like Investigations” (Interview, 6/2/09).

The second belief was that teachers needed opportunities to collaborate about content teaching. “They need to plan together and know what the lessons are and design common assessments to determine which students need interventions” (Interview, 4/3/09). Therefore she supported the concept of professional learning communities for collaboration and planning. Ms. Rojas, like the others, rarely attended PLCs. When she did attend teacher professional learning communities, teachers tended to take advantage of the opportunity to ask questions about non-instructional issues, “I went to the fifth grade PLC this morning and everyone wanted to know if their jobs were secure” (Interview, 4/3/09). In general, her

mathematics coach was responsible for facilitating the collaboration, without the authority to enforce teacher attendance or set the direction.

Third, Ms. Rojas believed that teachers needed opportunities to observe one another in teaching mathematics. She expressed two reasons for this. First, from her own “required” experience with walk-throughs, she came to believe that teachers could learn a great deal from one another by sharing their practices. She ran into the challenge of “what do teachers look for” on the walk-throughs, so she and the academic coach and the mathematics coach devised a form to guide their observations. The main focus of the “look fors” was on student engagement. “Each semester, teachers have to go with their grade level and observe one another teaching math. They have a list of “look fors” that they take with them. Then they meet with their PLC and talk about what they observed” (Interview, 4/3/08). Yet she did not participate in either the walks or in the ensuing discussions. Again, this responsibility was relegated to the coach. In addition, “just a handful of teachers can actually do the curriculum and understand it and see the benefits” so there were very few models to observe. The other reason she felt teachers needed to observe one another was to make their teaching practices public, hopefully igniting discussion and collaborative sharing.

### **Summary: Conceptions of Leading Mathematics Reform Initiatives**

*Setting direction.* Without knowledge of the curricula and without much confidence in her own knowledge of mathematics teaching and learning, Ms. Rojas relied on the district, her mathematics coach, and accountability mandates to set the direction for mathematics reforms at Sands. She appreciated the district adoption of the mathematics curriculum because “teachers will be more prone to do something that the district says you have to do as opposed to just listening to a principal. It’s an argument to have in my toolbox

that this is the way in the district” (Interview, 6/2/09). But not knowing the curricula herself meant that she could not recognize implementation on classroom visits, nor could she counter teacher complaints that “it’s too time consuming to make materials” and “the kids don’t get the skills” (Interview, 4/3/09).

After the first year, when she saw how much some of her teachers were struggling with the new curriculum, Ms. Rojas hired a mathematics coach. This dedication of school resources was a message to teachers that there was a focus on improving mathematics teaching and learning. While it is impossible to draw a direct link, students’ scores on the state standards-based assessment improved in mathematics, from 26% of students proficient to almost 43% proficient. The coach reported an increase in curriculum use during that second year, yet expressed frustration that there was no accountability for those who chose not to (conversation with mathematics coach, 6/2/09).

Ms. Rojas did send messages about curriculum fidelity. She wanted consistency in implementation of the reform curricula. By the end of the second year, she stated, “I’m going to push for consistency next year. I’m going to just take their old books away from them,” (Interview, 6/2/09) leaving teachers with only the adopted curriculum. But it was clear that the coach would be responsible for developing teachers’ skills to implement the adopted curricula, without an accountability incentive. In the same interview, she lamented about a poor teacher, “We were hoping she’d leave. I’ve not seen differentiation. We’d like her to step away from the worksheets. She is a level III teacher, but she can’t do it.” So there is an implied resignation that some teachers would never improve their teaching or implement the curriculum (Interview, 6/2/09).

Finally, improving test scores was a clear goal for her school, and like with Mr. Torres, it became the predominant measure of student learning in mathematics. The emphasis on accountability set a direction for Ms. Rojas and her school. She was very focused on showing student improvement on both the MAP and SBA scores in the spring, to the point that preparation for the assessments was cause to veer from the curriculum. “All of the standards have to be addressed before the test. My teachers say Investigations does not cover all of the standards in a timely fashion, so we need to figure out what else the kids need” (Conversation, 4/20/09).

***Develop people.*** Ms. Rojas believed that the strongest teachers of mathematics had a core of mathematics skills as a foundation and were able to make mathematics relevant for their students. Yet she expressed deep concern that she could not get district support to hire and keep good teachers at her school. By the second year of this study, she had seen tremendous staff turn-over and had many new teachers to support. In her comment that “teachers will use Investigations as the curriculum in summer school so if they didn’t know it before they will learn it” (Interview, 4/3/09) we see that she did not understand the sustained focused professional development and support that new and struggling teachers need to implement the curricula as intended. The coach could only support to the degree that teachers invited her help (Interview, 4/3/09). This meant that support was varied not by need, but by teachers’ motivation to seek it. The coach was available to model lessons, to co-plan, and to work with small groups of students.

Other than support from the coach, there was little professional development to build teachers’ content knowledge for teaching using a problem-solving curriculum. Ms. Rojas did encourage teams of teachers to participate in mathematics Lesson Study, and for each of

the two years of the study, Sands had a Lesson Study team. As the Knowledgeable Other<sup>4</sup> for that team, I noted that the lessons planned were not from the Investigations curriculum. “Oh, I just like to use problems I find” the teacher reported. Actually, the team planned only two lessons during the year, and the training did not extend to other professional activities with these teachers.

***Redesign the organization.*** There were aspects of the mathematics reforms that Ms. Rojas attempted to accommodate through organizational redesign. The first was that she was aware of the need for at least 75 minutes a day in every classroom for mathematics teaching and learning. This was added to the school’s Educational Plan for Student Success (EPSS). To ensure sufficient time, Ms. Rojas built a schedule that limited interruptions and pull-outs (for music and PE) to a minimum during instructional time. However, Ms. Rojas explained that there were teachers who still “couldn’t find the time in their schedule for that much math” (Interview 4/3/08), so even the EPSS did not drive teachers’ planning. Because there was not a mandated implementation of the curriculum, teachers were still designing their own mathematics instructional blocks.

The most significant “redesign” element at Sands was the hiring of a mathematics coach. This meant that teachers now had someone who was both available for support, and who was able to critique their pedagogy and mathematical understandings. Ms. Rojas gave the mathematics coach the charge of working with grade level teams to realign assessments to the curriculum and standards. However, both Ms. Rojas and her coach agreed that

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<sup>4</sup> In mathematics Lesson Study, the knowledgeable other is an outside expert who collaborates with the team “to enhance content knowledge, guide thinking about student learning and support the team’s work” (Yoshida, 2005, p. 4).

“without accountability to implement assessment or curricular changes,” change would not happen at scale.

Ms. Rojas focused her leadership efforts on trying to redesign the calendar to extend the school year. Perhaps because she did not feel strong in mathematics, she did not conceive of her role as leading reforms in classroom practices. She continued to believe that her efforts were best spent in finding a solution to students’ lack of home support, and her focus was on keeping them in school for more time.

Ms. Rojas recognized the challenges for teaching her unique population of students, and thus advocated for teachers who “work twice as hard” to catch them up and for more time after school to give students support. She was truly dedicated to improving student achievement, staying up many nights trying to develop interventions that would give students more time at school and more practice with vocabulary and SBA test items. But she conveyed two different conceptions of the direction she would set for her school. One was an ideal vision and the other an enacted role. In her ideal vision, teachers would collaborate to align their teaching and assessment practices, using the adopted curriculum. They would work in teams to critique and improve their mathematics instructional practices toward more rigorous, relevant teaching that engaged students. They would use data to motivate students and inform their work.

In practice, Ms. Rojas had tempered that vision. She conveyed a lack of confidence in setting the direction for and in supervising mathematics instruction. This admitted lack of leadership content knowledge extended through the LCK construct from the core subject of mathematics all the way to leading adult learners in the reforms. It was as though she did not see the classroom as under her purview. Since she did not feel comfortable being

directly involved with teachers related to the curricular reforms, she hired a mathematics coach to provide support. Even with a mathematics coach, classroom implementation of the

<b>Ms. Rojas Conceptions of Leading Mathematics Reform</b>
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reforms was left up to the individual teachers, since she did not have enough familiarity with the curriculum or the pedagogy to hold teachers accountable. She predominantly saw her leadership role as finding ways to create more time for students to be in school, such as changing the calendar or finding funding for after school tutoring. She looked for ways to enhance classroom practices by providing vocabulary lists and sets of take-home problems. She tried to support teachers who sought professional learning by observing and celebrating the Lesson Study lessons.

It was significant that she never became familiar with the reform curricula. She seemed such an enthusiastic participant in *doing* the mathematics in the focus interviews, yet she chose not to become involved in the reforms, as if overwhelmed by the learning curve. Her training in a more constructivist approach to teaching literacy gave her an idea of what to look for in mathematics classrooms, such as small group instruction, making teaching relevant and having students discussing their ideas. But the mathematics itself, understanding students' mathematical misconceptions and addressing them through an inquiry approach, and knowledge of how the curriculum supports the development of conceptual understanding were areas she did not venture as a leader.



<p><b>LCK:</b></p> <ul style="list-style-type: none"> <li>• Mathematics</li> <li>• Teach/Learn</li> <li>• Curriculum</li> <li>• Assessment</li> <li>• Adult Learners</li> </ul>	<ul style="list-style-type: none"> <li>• Expressed weak agency with mathematics</li> <li>• Very little understanding of curriculum</li> <li>• Believed students need to be motivated to do mathematics by engaging activities (relevance)</li> <li>• Hired mathematics coach to facilitate teacher professional teams focused on mathematics to develop classroom assessments aligned with curriculum, support teachers to improve instruction, model curriculum implementation,</li> <li>• Supervision focused on form due to lack of knowledge of function</li> </ul>
<p><b>Policy</b></p>	<ul style="list-style-type: none"> <li>• Implemented district accountability policy (MAP assessment and data review) according to district guidelines.</li> <li>• Felt little support from district for hiring and training teachers.</li> <li>• Believed in curriculum fidelity but cannot monitor.</li> <li>• Implemented teacher “walk-about” to include them in the walk-through observation protocol.</li> </ul>
<p><b>School Context</b></p>	<ul style="list-style-type: none"> <li>• Believed students need more time at school.</li> <li>• Set strong direction toward year-round school and after-school tutoring.</li> <li>• Obtained information about curriculum and student work habits from teachers, not from observation or experience in classrooms.</li> </ul>

### Concluding Remarks

The participants in this study each expressed views of leading mathematics reform that were a result of their own personal stories of mathematics, their leadership content knowledge, their unique school contexts, and their sense-making about policies related to the reforms. Their conceptions were dynamic, responding to new information they received to inform their LCK, to policy messages, and to the continually evolving social context of their individual schools. In the final chapter, I look across cases to analyze themes that illuminate the interplay of LCK, social context, and policy interpretation.

## Chapter 7: Cross-case Discussion and Conclusions

Chapter 1 of this dissertation introduced the concern that although mathematics reforms have been on the national agenda for over 20 years, we still do not have reform at scale. Many students are not exposed to opportunities to learn relevant and rigorous mathematics, and this is more likely to be true in schools that serve poor communities (Kitchen, Depree, Celedón-Pattichis, Brinkerhoff, 2007; NCTM, 2000; NRC, 2001). Moreover, the largest variations in students' mathematics experiences can exist *within* schools due to marked differences in teaching practices and curriculum implementation (Hannaway, 2009; Newmann, King & Youngs, 2000). Researchers have suggested that district and school leadership play a significant role in scaling up reforms (Burch & Spillane, 2003; Cobb & Smith, 2008; Nelson & Sassi, 2005; Spillane, 2002), yet we have very little research to inform us about how principals conceive of their leadership roles and what shapes their conceptions.

Chapter 1 presented an episode with one of the study's participants, Ms. Rojas, as she struggled to find a way to provide leadership and support for a teacher who was "ready to quit" over the new mathematics curriculum. In her struggle, four challenges were highlighted: the challenge of guiding teachers to make the paradigm shift required to enact the reforms; the challenge of providing all students access to rigorous and relevant mathematics in a traditionally underperforming school; the challenge of meeting district and state accountability demands to improve student proficiency in mathematics; and the challenge of navigating the mathematics reforms through the unique situational context of the school. These challenges formed the basis of the study's research sub-questions.

In Chapter 6, these research sub-questions guided an analysis of each principal's conceptions about leading mathematics reform in her/his school. A picture emerged of how individual leadership content knowledge, interpretations of policy messages, and abilities to navigate and develop the school climate to accommodate the reforms all shaped principals' ideas about leading change. Each principal's story reinforced the premise that leadership in the content area is complex and multifaceted.

In this chapter, I shift the lens of analysis to look across the three cases in an attempt answer the primary research question: How do principals in predominantly Hispanic-serving schools conceive of their leadership roles in the implementation of a district-wide mathematics reform initiative? A cross-case analysis highlights some of the important similarities and differences in principals' conceptions of mathematics leadership and provides evidence of some of the challenges for improving mathematics teaching and learning at scale. To analyze the similarities and differences in conceptions, I employed the broad theoretical constructs that framed this study: leadership content knowledge and sense-making. Several matrices were used to organize and sort the data, as shown in the examples in Appendix D. Three significant broad themes emerged, and are discussed below: 1) principals as brokers of policy; 2) principals' LCK and their leadership of adult learners in implementing the reforms; and 3) how principals navigate mathematics reform within their unique school contexts.

### **Principals as Brokers of Policy**

In the analysis, four important district policies emerged as influential in principal leadership of mathematics reforms: accountability policy; curriculum policy; supervision

policy and equity policy. Figure 7.1 represents an example of the format used to compare and analyze the data across cases according to the four policies.

<b>Policy</b>	<b>Mr. Torres</b>	<b>Ms. Passos</b>	<b>Ms. Rojas</b>
<b>Accountability</b>	<ul style="list-style-type: none"> <li>• “the data guy”</li> <li>• looked for teaching gaps</li> <li>• standards and data</li> </ul>	<ul style="list-style-type: none"> <li>• helped teachers to look at student work</li> <li>• looked for teaching gaps</li> </ul>	<ul style="list-style-type: none"> <li>• posted data</li> <li>• did not “drill”</li> </ul>
<b>Curriculum</b>	<ul style="list-style-type: none"> <li>• did not know</li> <li>• strong teachers didn’t need</li> <li>• weak teachers need</li> </ul>	<ul style="list-style-type: none"> <li>• knew curricula</li> <li>• no curriculum 100%</li> <li>• teacher push back “why change”</li> </ul>	<ul style="list-style-type: none"> <li>• did not know</li> <li>• wanted fidelity, didn’t hold accountable</li> <li>• weak teachers need</li> </ul>
<b>Supervision</b>	<ul style="list-style-type: none"> <li>• looked for form over function</li> <li>• his role to support math</li> <li>• walk-through ok</li> </ul>	<ul style="list-style-type: none"> <li>• look for form and function</li> <li>• walk-through backfired</li> </ul>	<ul style="list-style-type: none"> <li>• looked for form over function</li> <li>• Did not do frequent walk-through</li> </ul>
<b>Equity</b>	<ul style="list-style-type: none"> <li>• make mathematics relevant</li> <li>• language of instruction</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• collective responsibility</li> <li>• relevance</li> <li>• interventions</li> </ul>	<ul style="list-style-type: none"> <li>• make mathematics relevant</li> <li>• more time at school</li> <li>• teach in English for test</li> </ul>

**Figure 7.1 Sample Format Used to Compare and Analyze Data**

While all three principals received the same policy representations from the district, their role conceptions of brokering policies within their schools differed. What follows is a discussion of the four policy themes as they related to principals’ conceptions about leading mathematics reform. For each theme or policy, I first present a short summary of the district’s expectations and messages, setting direction for the reforms I then discuss the major sub-themes that emerged across the cases.

**Accountability policy and principal role conception.** Three sub-themes related to policy emerged in the cross-case analysis that will be discussed below: the accountability messages were very strong, and thus trumped other policy messages; principals brokered those messages according to their leadership content knowledge, including knowledge and understanding of the data; and school context could influence a leader's ability to broker policy. To set the context for the discussion, I begin with a summary of the district policy messages

*District accountability policy messages.* Principals indicated that the district communicated very specific and measurable policies about assessment and accountability related to mathematics. The policies specifically addressed two assessments: the state standards-based assessment (SBA) and the short-cycle assessment (MAP) administered three times a year to all students grades K-8. These assessments carried considerable weight throughout the district because the data was used to compare schools, classrooms, and to assess teaching practice. Throughout the two years of the study, district principal meetings included training in the use of this standard assessment data. All three principals referred often to required data charts and standard templates that represented their school's progress toward student proficiency in mathematics on the short-cycle assessments (website). Proficiency trends were made public to the School Board by school, by grade, and by teacher. Accountability policy messages significantly impacted principals' ideas about leading the reforms.

*Findings related to the strength of accountability message.* A key finding across cases was that improving students' mathematics scores on the MAP and the SBA became a primary focus of principals' instructional improvement efforts. Each principal had similar

graphs and charts of student proficiency by classroom and they all knew the MAP proficiency targets for each grade level. They all equated strong teaching and student learning with strong scores. The power of accountability policies to influence principals' leadership decisions became evident when they perceived a conflict between two policies. Meeting proficiency expectations on the MAP and state-mandated standards-based assessments trumped curriculum policy. For example, Mr. Torres and Ms. Passos were hesitant to press for fidelity to the district curricula if teachers were showing good progress with their students' mathematics proficiency on the MAP assessment.

*Findings related to principals' LCK and data use.* How principals conceived of MAP and SBA data use for setting the direction for the reforms varied, depending on each principals' LCK and knowledge and understanding of data-driven decision making. Mr. Torres was the most comfortable with data-driven decision-making, particularly related to the MAP and the SBA. His interview data contained more than three times the references to data than the other principals did. He, more than the other principals, used MAP and SBA data to set the direction for the reforms, and he led his teachers in learning how to "data drill" to discover which of the content strands had "teaching gaps" and where teachers needed to focus their instruction. He coupled his knowledge of the content strands and standards for mathematics with his interpretations of the data as he worked with teachers. "The MAP data showed that we weren't doing enough with the data and probability strand" (Interview, 4/2/09).

Ms. Passos also asked her teachers to drill into the data to look for teaching gaps. However, her understandings about mathematics teaching and learning led her to see how the MAP assessment could be misleading about a student's mathematical understandings.

“I’ve learned that MAP is not such a good indicator for ELL students. One girl got a 2% on MAP scores, but other assessments in Spanish showed she was at 95% proficiency” (3/11/09). So she began to work with her teachers on looking at classroom formative assessments, including looking specifically at student work for mathematical understanding. She set a direction for teachers to become collaborative with data and share responsibility for all students to become successful according to standards, not just according to short-cycle assessments.

Ms. Rojas, who felt the least comfortable with mathematics teaching and learning, relied solely on data to inform her about teacher effectiveness and student progress. She used class proficiency levels on MAP assessments to “rate” teachers. The work of actually drilling into the data to discover teaching gaps was delegated to her mathematics coach. Thus, she did not interface with teachers about using data from the assessments to drive their mathematics instruction.

*Findings related to accountability and school context.* A third major finding related to accountability policy was that principals perceived the NCLB (2002) requirements for AYP had the potential to motivate instructional change in their schools. Mr. Torres emphasized the need to improve student proficiency. “We can’t send only 17 out of 70 students proficient to the middle school!” and “We need to beat Peralta [on the SBA]!” His enthusiasm for improving was like that of a winning basketball coach, using game stats and scores to promote improvement. After all, they were close to making AYP. On the other hand, Ms. Passos perceived that her teachers were not motivated to undertake the challenges of reforming mathematics teaching precisely because they had been successful at meeting AYP every year. She was not able to use that district “leverage” to

create the will and set the direction for the reforms. And finally, for Ms. Rojas, the accountability measures seemed to only serve as a reminder of the challenges at Sands. She kept her focus more on complying with the required charts and graphs, and found bits of hope when students responded positively, “Look, I went up ten points” when they made improvement on short-cycle assessments.

Accountability policy had a strong influence on principals’ conceptions of mathematics reforms and their leadership roles. Improving student proficiency on district and state assessments superseded other policy messages, as well as many of the ideas and understandings about the reforms. The most glaring example was each principal’s struggle with curriculum fidelity. If teachers could show that their students were proficient in mathematics according to MAP, the principals did not press them to use the reform curriculum.

**Curriculum policy and principal role conception.** There were three significant findings related to curriculum policy: accountability concerns trumped curriculum fidelity concerns; the introduction of supplemental programs diffused the curriculum fidelity message; and principals did not have the deep understanding of the curricula that is required to discern discrepancies between the *intended* (as written by publishers) and the *enacted* (taught) curriculum (Remillard, 2005). They also did not appreciate the intensive supports needed by teachers to implement the reforms. Because of these challenges, each struggled to respond to the push-back from teachers who could not make the paradigm shift required by inquiry-based curricular materials and pedagogy. Again, I begin the discussion with a summary of district policy on curriculum.



***District curriculum policy messages.*** The adoption of a district-wide mathematics curriculum was intended as the catalyst for mathematics reform in general. In her research on teachers' use of mathematics curricula, Remillard (2005) noted that districts often mandate the use of a single curriculum "to regulate mathematics teaching practices" (p. 211). That is very much what happened in the Las Palmas schools. In hopes of changing teacher practices, district leaders believed that the materials would promote the reforms. However, the limited training opportunities provided for teachers show that district leaders did not appreciate the depth and breadth of support required to bring about substantial change in curriculum and pedagogy. Thus principals had to rely on their own ideas about developing teachers' facility with both the curriculum and the pedagogy.

Unlike accountability representations, curriculum messages from the district were somewhat ambiguous and thus susceptible to principal interpretation. In addition, because fidelity of implementation was difficult to measure and monitor at the district level (Cobb & Smith, 2008; Remillard, 2005), principals had a great deal of discretion in supervising and holding teachers accountable for curriculum implementation within their schools (Nelson, 1998; Nelson & Sassi, 2005). An analysis of the three cases showed that all of the principals were ambiguous about curriculum fidelity.

***Accountability policy trumps curriculum policy.*** It is not difficult to imagine why principals conceived of their role in leading accountability mandates more clearly than in promoting the reform curriculum. While the district attempted to couple the accountability messages with the implementation of a reform curriculum, the accountability messages were delivered with more authority to principals and teachers alike. Accountability policies were unambiguous, tied to federal mandates, measurable, and public; and required specific

hard documentation of progress toward proficiency. Curriculum policy was not so clear. In fact, principals reported that the only curriculum accountability was to look for fidelity of use during classroom walk-throughs and to suggest the percentage of teachers who were implementing the programs. As Mr. Torres noted, “a report of 60% was nebulous because the data relied on a principal’s ability to discern implementation of the curriculum as it was *intended* to be used, from the actual *enactment* of the curriculum, which is similar to other research findings (e.g., Remillard, 2005).

While the principals all seemed to want their teachers to move in the direction of using the reform curriculum as the core, none committed to enforcing implementation with teachers. Although both Mr. Torres and Ms. Passos conveyed a strong sense of agency with the teaching and learning of mathematics, and appreciated the inquiry approach, they expressed concerns that Investigations and CMP2 might not be comprehensive enough to address computational and procedural fluency in mathematics. This mirrors research on teachers’ concerns as they embark on reforms, that “at some point we have to decide that the curriculum materials themselves are good enough – ready for teachers to use and revise in their own classrooms” (Russell, 1997, p. 251). As leaders, none of the principals had decided that the curricula were “good enough” for the whole school to implement, which led to concerns of improving the teaching and learning of mathematics at scale. They each had a number of “good teachers” whose students were achieving, who were using their own materials, not fully implementing CMP2 or Investigations. So when principals were faced with curriculum fidelity decisions in their schools, they did not press teachers to comply if their MAP and SBA scores were good. Mr. Torres and Ms. Passos indicated a strong sense of agency with mathematics, which afforded them insight into teaching practices that were

effective. Ms. Passos spoke of a teacher's use of building writing and thinking skills in mathematics by providing a written structure for expressing mathematical thinking, which she believed allowed her to know successful mathematics teaching when she observed students' work. The problem was that principals were finding it difficult to improve mathematics teaching at scale because the good teachers were "doing their own thing" and getting good results on the MAP and SBA. As Mr. Torres noted, this meant weaker teachers "couldn't learn from the good teachers because it's too hard to follow what they're doing" (Interview, 4/2/09). So mathematics instruction continued to vary by teacher.

*Ambiguity of curriculum policy message.* A second finding related to curriculum policy and mathematics leadership was that the district's introduction of supplemental programs diffused the message to principals and teachers about curriculum fidelity. Certainly it could be argued that all teachers and principals in the district received a clear message that the intention was to implement the reform curricula. Teaching materials were purchased district-wide. Training by the publishers was mandatory for all teachers, and during the first year, teachers were expected to attend monthly workshops to further support implementation. However, the district also brought in materials and training for two supplemental programs designed to improve students' number literacy, programs that also required substantial new learning for teachers about how to look for student conceptions and misconceptions (Garlikov, 2009). Each of the three principals spoke of how teachers and students seemed to like the Dots and Grids activities from the supplemental program, which sometimes replaced or superseded the curriculum lesson. Also, the balanced mathematics framework indicated only 45 minutes for the curriculum lesson. The rest of the 60-75 minute block was filled with Number Literacy review, and fluency practice. This did not

align with the policy representation within the adopted curricula, both of which call for 60 - 75 minutes for the lesson. Since Mr. Torres and Ms. Rojas did not know the curriculum well, they could not know that both Investigations and CMP2 have included fluency practice and number literacy through daily routines and mathematics games. Even Ms. Passos, who knew the curricula the best, did not “trust” that they reinforced all the basic skills for students.

*Deep curriculum knowledge.* Curriculum knowledge is directly related to leadership content knowledge for teaching and learning mathematics. Remillard (2005) suggests that supervisors must have deep understanding of the curriculum in order to discern discrepancies between the intended and the enacted curriculum. Unless a principal knew exactly what she was looking for in terms of the goals of the lessons, the “launch” (Lappan, Fey, Fitzgerald, Friel, Phillips, 2007) of the lesson, and students’ interaction with the mathematics of the lesson (the intended curriculum), it was very difficult to assess the lesson (enacted curriculum) [Drake & Sherin, 2002; Remillard, 2005; Senk & Thompson, 2003]. Ms. Rojas said, “I just look to see if the students are engaged in the lesson. I don’t know if it is Investigations or something else” (Interview, 4/3/09). Mr. Torres commented that he “knew Mr. M. was teaching a CMP lesson,” but he did not know which part of the lesson should have been teacher directed and which part should have been student group-work because he did not know the curriculum. Principals received no specific training on either the curriculum itself or the challenges it presented for teachers. They were invited to teacher professional development, but of the three in this study, only Ms. Passos attended more than one training. During classroom observations, all three principals focused more on

the student engagement and the role of the teacher than on curriculum implementation. This is likely attributable to their lack of familiarity with either Investigations or CMP2.

Perhaps because principals did not deeply understand the curricula, they did not understand the complexities of enacting the curriculum as intended. Mr. Torres and Ms. Rojas both made comments that reflected a misunderstanding of the rigor and consistency intended in the reform curricula: “I have teachers who use it three days a week” (Mr. Torres, 4/2/09), “They have to teach it in summer school so they will learn it if they haven’t already tried” (Ms. Rojas, 6/2/09) and “I tell my weaker teachers they have to use Investigations” (Mr. Torres, 2/11/09). The principals did not reflect on their role in providing the substantial support that research has shown teachers need in learning to implement a new reform curriculum. “They need to learn about the content, goals, approaches, and underlying assumptions of the curriculum they are being asked to use” (Remillard, 2005, p. 239).

**Supervisory policy and principal role conception.** Two sub-themes emerged in the data: 1) the walk-through checklist reinforced principals’ tendencies to look for superficial aspects of mathematics instruction, unless their leadership content knowledge (LCK) was strong; 2) supervision was discretionary, so principals varied in how they held teachers accountable for implementing the reforms. A short summary of district policy on supervision contextualizes these findings.

*District policy on instructional supervision for mathematics.* To support the expectation for implementation of the reform curriculum, the district implemented additional requirements for principal supervision of teachers. As a part of a larger goal to ensure that principals were getting into classrooms as instructional leaders every week, the

district required principals to conduct 3-5 minute walk-throughs of 90% of their classrooms every week. The district's introduction of the supervisory checklist that included "look fors" in mathematics teaching served to highlight how each school's climate for change influenced principals' supervisory role and their ability to promote the reforms at scale.

***Focus on superficial aspects of mathematics instruction.*** The district's walk-through checklist, as discussed in Chapter 5, left a great deal of room for principal judgment. As Spillane's research predicted (2000), the checklist, which focused principals' attention on manipulatives, small groups, math word wall, and student engagement, promoted form over function. In a 3-5 minute walk-through, principals were encouraged to focus on teacher behaviors and student attentiveness (form), rather than student responses and student understanding (function). Without knowledge of the intended curriculum and a deep understanding of how pedagogical strategies and tools supported student understanding of mathematical conceptions and misconceptions, principals relied on the checklist to guide a teacher-centered conception of teaching and learning, rather than how students are constructing meaning in the mathematics classroom (Grant et al., 2006). For example, Mr. Torres noted 85% engagement in a mathematics lesson where some students were raising their hands. When I asked how hands raised indicated engagement, he replied, "Well, they were paying attention."

The requirement to observe for brief periods in many classrooms every week did not guarantee that principals knew what to look for, or how to discuss their observations with teachers. Mr. Torres, who felt confident about his ability to guide teachers to improve mathematics teaching, was actually very focused on teacher moves and on superficial aspects of student engagement. For example, he claimed he observed 85% student

engagement, when in fact the only evidence of engagement was that some students were raising hands and none were disruptive. An emphasis on form was also revealed in Ms. Rojas' comment that she looked for manipulatives, small groups, and student engagement. She knew what she liked and did not like in her observations. She appreciated lessons that involved students "in hands-on problem solving and got them engaged" but was unaware if the teacher had missed the big mathematical idea of the lesson. Ms. Passos, who conveyed the strongest knowledge of the reform pedagogy and curriculum, was the only one to discuss observations of student work. However, she found the checklist did not serve as a tool to promote instructional improvement. Rather, she found that it threatened teachers who were already uncomfortable with change.

*Supervision discretionary.* The walk-through checklist was an attempt to help principals hold teachers accountable for implementing the curriculum and following the district's balanced mathematics framework. There was no way to hold principals accountable for observing and supervising mathematics lessons since the checklist also served for literacy observations. Thus the walk-through checklist left a great deal of room for principals' discretion. Ms. Rojas, who felt unsure about both her mathematical skills and the curriculum, observed mathematics lessons infrequently. She had her mathematics coach for that. Ms. Passos, whose teachers were threatened by the walk-through model, chose to abandon it and move toward a more collaborative structure where grade level teachers worked together to develop interventions for struggling students. That was where she felt she could influence the instructional conversations, and where she had to begin to gain teachers trust again. Mr. Torres did observe mathematics lessons regularly, feeling it was his role to guide teachers' mathematics instruction. When he did use the checklist, he left a

copy for the teacher, which often inspired a conversation about the lesson. The district's introduction of the walk-through checklist served to highlight the differences in each principal's conception of their supervisory role.

**Equity policy and principal role conception.** Equity policy was the least defined of the four district policies related to the mathematics reform initiative. The overarching theme that emerged related to equity policy was that the district policy representations were broad and implicit, leaving much to the interpretation of individual principals and schools. Principals relied on their own understandings and on that of their teachers to figure out how to set a direction for mathematics teaching and learning that would create greater opportunities for their traditionally underserved students. Those understandings emerged as three sub-themes related to principal sense-making about equity policy: making mathematics instruction relevant to students' lives was key for all principals; by following policies to find all struggling students and provide interventions, data specific to subgroups had not been analyzed; and accountability to improve standards-based assessment scores impacted principals' ideas about language of instruction in mathematics classrooms. These themes are discussed below, following a summary of the district's equity policy.

***District equity policy messages.*** This study was purposively set in schools with large Hispanic populations, which provided the context to explore principals' leadership vis-à-vis the Equity Principle (NCSM, 2008). The Principle states, "it is the responsibility of mathematics education leaders to ensure underperforming student populations are identified and to . . . address identified gaps in student achievement and identified gaps in access to the curriculum" (NCSM, 2008, p. 10). In the Las Palmas district, there were clearly identified gaps. While 65% of the students were Hispanic, there was a 17% gap in



mathematics proficiency between Caucasian and Hispanic students (23% of Hispanic students proficient to 40% of Caucasian students) in the 6<sup>th</sup> – 8<sup>th</sup> grades. District policy on equity was broadly conveyed in the mission statement, “Every student, every year, at or above grade level” (district website). The district sought to address identified gaps in student proficiency in two ways: the use of short-cycle assessments (MAP) to find the teaching and learning gaps, and the requirement for schools to provide interventions for students who were not proficient. Beyond that, there were no policies that guided schools to develop programs and strategies to meet the diverse needs of all students. Thus principals were left to work within their own schools, with their own understandings of equity, to improve opportunities for all students to learn rigorous and relevant mathematics, something research has shown to be a formidable task (Ladson-Billings, 2001; Tate, 2007).

***Making mathematics relevant.*** All three principals believed that it was essential for students to understand the relevance of mathematics in their lives. The principals spoke of pedagogical moves, such as “activating prior knowledge so you can tie the lesson to what they already know” (Ms. Rojas, Interview, 4/2/09). These are practices supported in the literature on improving students’ opportunities to learn mathematics in diverse schools (Flores, 2007; Lee & Luykx, 2005). Mr. Torres spoke of “telling” teachers how to relate skateboarding to degrees in a circle; Ms. Passos told of finding a “buddy” for students who might not have access to homework support at home; Ms. Rojas wanted to see more engaging problems and lesson openers that “activate prior knowledge”. However, they differed in their comfort with mathematics and in their familiarity with reform pedagogy, and they held different conceptions of their leadership roles in helping teachers to increase the relevance of their instruction. Mr. Torres felt it was his role to coach or “tell” teachers to

try different approaches. He gave them specific examples of what to change. “I told her she had to use examples that these kids can understand. They know about cars. They know about wheel sizes. So I told the teacher to make her geometry lesson about the diameter of tires” (Interview, 9/9/08). He was very direct and used his own confidence in teaching math as his guide. Ms. Rojas talked about what she wanted to see, but not of her role in changing teachers’ practices. “I want them [teachers] to activate their prior knowledge and to relate math to their lives.” But she never spoke directly of her role in leading them to achieve this, other than communicating her vision to the mathematics coach. Ms. Passos also emphasized the importance of relevance and tying mathematics lessons to students’ lives. But she did not see her role as setting a direction for relevant teaching so much as for building a system where struggling students had intensive adult support. In terms of developing the capacity of their teachers to improve mathematics teaching for equity, none of the principals spoke specifically about working with all teachers to design an intervention specific to access and opportunity-to-learn issues (Tate, 2007). The PRIME Equity Leadership Principle (NCSM, 2008) states, “Leaders will engage teachers in the development and implementation of lessons that reflect the importance of relevant, meaningful mathematics” (p. 15). Yet, other than Mr. Torres’ one-on-one guidance to teachers and Ms. Rojas hiring of a mathematics coach, the principals did not talk about a leadership role to help teachers develop such strategies. While they appreciated the importance of connecting mathematics to students’ lives, they did not explicitly articulate a leadership role for ensuring that the language of mathematics “be introduced in ways that respect and build on the learner’s other cultures and indigenous knowledge” (Moss et al., 2008, p. 347).

***Principal conceptions of analysis of data on specific sub-groups.*** Data-driven decisions take many forms, and multiple sorts of data can inform decisions about teaching and learning. As national studies have found (Marsh, Pane a& Hamilton, 2006), the three principals all looked at the results of MAP and SBA testing to discover which students needed mathematics interventions. But little attention was paid to performance trends and data on specific subgroups. While data on ELL student performance in each strand of mathematics was available for principals who knew how to “dig” for it, none of the three principals had done so. The broad policy to provide interventions for all students not proficient on the MAP and SBA assessments led all three principals to require teachers to look at proficiency scores on individual students, but not on subgroups of students. Mr. Torres spoke about drilling into the overall test data to find which standards teachers might need to focus on more, but admitted he had not had his teachers look specifically at where ELL students were struggling in mathematics. This was also true for Ms. Passos. For her, there were bigger issues, and besides, “they are only 8% of my students, and most of them speak English.” Ms. Rojas had not even considered looking at where the teaching gaps for ELL students might be. It appeared to be an idea the principals had not conceived of, and the district policies did not guide them to consider it.

***Principal conceptions of language of instruction.*** The three principals had quite different ideas about teaching mathematics in English or Spanish, and thus conceived of leadership in different ways. Ms. Rojas, whose school served over 60% ELL students, believed it best to prepare students to be successful on the SBA in English. She also advocated more English in teaching mathematics. She did not conceive of her role as leading the school in considering language of instruction in mathematics. In fact, she

explained that her bilingual teachers had considerable autonomy in how they approached instruction, with some teaching mostly in English with some translation, others teaching half a year in English and half a year in Spanish, and still others alternated English and Spanish week by week. All of the mathematics materials were in English, which left language support up to the teachers.

Mr. Torres seemed to be in the process of changing his ideas about language of instruction for mathematics and thus was uncertain about how to set the direction with his teachers. In an early interview, he suggested that mathematic “is the universal language” and therefore in a bilingual classroom, it is the subject that can be taught in English. However, although he began by advocating for mathematics in English to prepare students for the SBA assessment, he had become familiar with some of the research that suggested students need to grasp the new concepts in their native language first (e.g. Cummins, 1994). An example of this shift was when he instructed a teacher to teach mathematics to her classroom of Spanish speakers in Spanish. When I asked about student materials in Spanish, he replied that the teacher had to find a student book and make her own copies. At the end of the project, he was still forming his ideas about best practice and what language of instruction would best prepare students to take the SBA in English. “We have to get them good at doing math in English, too, because the test is in English, but at some level they just need to learn the math” (Interview, 4/2/09). What is significant in these examples, however, is that, while Mr. Torres admitted he was still working with a team of teachers to formulate a plan and best practices for language in the content area, ELL students from Tomasita were far less likely to end up in remedial mathematics courses in middle school than students from Sands (Mr. Torres and Ms. Rojas, 4/2/09). Mr. Torres and Ms. Passos (who had

worked previously at Tomasita) believed this was because teachers had high expectations for all students, and adjusted language of instruction to meet individual students' needs.

Ms. Passos was pleased that most of her teachers had bilingual or TESOL certification, but felt there were too few Spanish speakers to really consider teaching mathematics in Spanish. She advocated for putting a mono-lingual Spanish speaker with a bilingual student for translation. She had significant knowledge of second language learners from her experience at Tomasita, and stated that, "If I were at Sands, we would have math taught in Spanish until they could transition to English." But she had little to say about her role in addressing the low mathematics proficiency scores of ELLs at Camino Real.

Principals' ideas about language of instruction in the mathematics classroom were dynamic and varied. This led to different conceptions of how to set the direction for teachers. Mr. Torres and Ms. Passos seemed to have been in a process of forming their ideas about language of instruction. All three schools had varied approaches within individual classrooms. The lack of direction from the district meant that this variation in approaches to language of instruction would continue in all three schools.

While this set of findings addressed the importance of district policy messages in principals' sense-making about leading mathematics reform, the findings also emphasize the importance of LCK in interpreting and brokering policy. The second broad theme related to the cross-case findings relates to principals' LCK and leadership of adult learners.

### **Principal LCK and Leadership of Adult Learners**

A significant aspect of leadership content knowledge has to do with assisting teachers to improve their pedagogy, including curriculum implementation, and to improve mathematics teaching at scale. This aspect of leadership content knowledge requires

knowing something about teachers as learners and about effective professional development and collaborative communities of practice (Cohen & Hill, 2000; Nelson & Sassi, 2005; Stein & Nelson, 2003). Principals need to understand that standards-based mathematics classrooms and the use of standards-based curricula, “with their emphasis on mathematical thinking and reasoning, pose new challenges” (Grant et al., 2006, p. 1) for teachers and for principal leadership. Principals face significant challenges in moving teaching and learning toward the active construction of meaning around mathematical big ideas (Ball, 2004; Grant et al., 2006). It requires an understanding of the comprehensive support systems teachers need.

There were two important findings related to LCK and leading adult learners. First, principals varied in their conceptions of how to support teachers in implementing the reforms. Second, principals varied in how they held teachers accountable for implementing new learning.

**Supporting teachers.** All three principals appreciated that many of their teachers struggled to change their instructional strategies and pedagogy for teaching mathematics with a problem-solving approach. Like Ms. Rojas’ teacher in the vignette, the challenges of a new curriculum that also required pedagogical change was too much for some teachers. Principals also identified teachers’ lack of mathematical knowledge as an additional concern. While there were some similarities in how the three principals conceived of supporting teachers to develop the skills to implement the reforms, there were also differences.

All three schools had created schedules so that teachers had grade-level collaboration time during their duty day. They all spoke of these collaborations as

professional learning communities, to serve as a venue for teachers to talk about the teaching and learning of mathematics and literacy. And all three sent their academic or, in the case of Ms. Rojas, mathematics coaches to facilitate the collaborative sessions. All of the principals spoke of a desire to focus teacher collaboration on mathematics teaching and learning. But the substance of the work in these professional development sessions varied. Ms. Rojas spoke of wanting her coach to lead teachers in activities such as developing assessments that were aligned with the standards in order to better understand student proficiency in mathematics. Mr. Torres wanted his coach to have the teacher work together to drill into assessment data to look for teaching gaps in each of the mathematics strands (NCTM, 2000). Ms. Passos hoped to guide teams of teachers to look together at student work to learn more about student conceptions and misconceptions. But the principals rarely attended the collaborations. Mr. Torres delegated the facilitation of collaboration to his academic coach, who he described as a teacher leader who “did not know much about mathematics because she was trained in literacy.” Ms. Passos also rarely attended collaboration because, “teachers feel threatened and don’t talk freely if I am there.” Ms. Rojas delegated the facilitation of teacher collaboration to her mathematics coach because, “I don’t know the math.”

In addition to professional learning communities for teacher collaboration, principals had ideas about how to support teachers in the classroom. The way they conceived of supporting teachers in practice varied, and was related to their LCK. Mr. Torres, who felt confident about his own experience as a mathematics teacher, felt he was supporting his teachers by giving them teaching tips like, “you need to do more small group instruction” (Observation, 12/8/08). His academic coach had been hired as a literacy coach, and was not

strong in mathematics teaching, so Mr. Torres felt it was his responsibility to provide individual support to teachers. Related to LCK and the teaching and learning of mathematics, he considered himself knowledgeable about a problem-solving approach to mathematics teaching and learning. But he was not familiar with the curricula, thus he focused his comments on teacher moves (form) and on relevance of the material. This meant teachers received no ongoing expert support in learning the new curricula. In addition, his lack of deep understanding of the challenges of the new curricula led him to believe that struggling teachers could improve student proficiency with fidelity of implementation. By the middle of the second year of the reform initiatives, Mr. Torres realized that his weaker teachers needed strong teacher models, which led him to consider requiring all teachers to implement Investigations and CMP2 the third year. For many of his teachers, Mr. Torres was really the sole source of mathematics support throughout the year.

Ms. Passos, who also felt confident in mathematics, teaching and learning, felt strongly that she wanted to build a “learning community” where teachers shared best practices in teaching pedagogy. She envisioned herself leading a professional learning community where mathematics teaching became transparent, and teachers held each other accountable for improving practice. However, because many teachers were resistant to change, she felt she needed to start with activities that were not threatening to teachers, either due to the complexity of the mathematics or fear of sharing their practice. So she started with the whole staff, looking at samples of student work taken from the state accountability website. She, also, did not talk of any substantial ongoing support for teachers in implementing the reform curricula, but “I support them if they find it on their own!”



Ms. Rojas, who claimed weak mathematics knowledge, struggled the first year to support teachers who were “having breakdowns over the new mathematics curricula” (6/2/08). She felt by the second year that her teachers needed the support of a mathematics coach to help them to learn new practices. She asked her coach to be available to support teachers in the classroom and to attend teacher collaboration in order to facilitate discussions about using the reform curricula. With a coach in place, she essentially took no role in mathematics teaching and learning.

Within this theme of supporting teachers, a small but interesting finding emerged across the three cases that highlights the discrepancy between what principals believed *should be* happening in mathematics teaching and learning and the kind of support they offered to ensure that it *was* happening. The finding relates to research that emphasizes the importance of developing teaching strategies that allow students to access the language of mathematics that is necessary for developing mathematical ideas (Celedón-Pattichis, 2004; Khisty, 1995). Interestingly, all three principals believed that teachers’ focus on mathematics vocabulary was an important “look for” in their observations of teachers because “these kids haven’t been exposed to things like radius or ratios unless their dad or mom is an engineer” (Ms. Passos, 3/11/09). All three believed that students needed more experience with the vocabulary of mathematics. They each spoke of the importance of what Khisty (1995) and Moskovich (2007) refer to as the mathematics register, relating how many of their students were confused by instructions like “draw a table” in mathematics problems. However, other than emphasizing “vocabulary use” as an item on the “classroom walk-through checklist”, none of the three indicated how they might support teachers in learning more about this aspect of mathematics pedagogy. In other words, this aspect of

instructional pedagogy seemed important to all three principals, yet they had not raised it as an issue to be addressed by teachers. As Ms. Passos explained, “I’ve told teachers I am looking for vocabulary use and math word walls,” but she had not addressed the broader issue of mathematical discourse. So if the direction principals hoped to set was to build teachers’ ability to consider the academic language of mathematics and the mathematics register, they had not conceived of a way to provide professional support for teachers to learn this skill.

This example serves to highlight the fact that none of the principals articulated a plan for ongoing professional development that specifically targeted the reform curriculum and reform pedagogy. Other than Ms. Rojas’ mathematics coach, they all stated that they did not have expertise within their schools to guide this focused learning. Nor did they mention efforts to seek ongoing support from outside the school.

**Holding teachers accountable for new learning.** What is significant in these findings is that none of the three principals spoke of a leadership role that effectively combined support with holding teachers accountable to specific teaching practices. Rather, they talked of holding teachers accountable to improving student proficiency scores. Mr. Torres came the closest when he spoke of giving teachers pointers and of “pushing them to do more group work” or “telling them to teach in Spanish”. But he admitted that he did not hold them accountable for implementing the curriculum. He pushed teachers very hard on the form aspects of teaching, like group work and relevance. But what he described was spontaneous support, when he observed the need, rather than systemic transformational support. Ms. Passos found that many of her attempts to hold teachers accountable backfired due to teacher resistance. Ms. Rojas provided perhaps the most consistent support to

teachers in the form of the academic coach, but she did not follow through in holding teachers accountable to implement reform practices because she felt she did not have the knowledge. With a coach in place, she essentially took no role in mathematics teaching and learning.

Leadership content knowledge for leading change in a community of adult learners was a struggle for these leaders. Some struggled with the mathematics, like Ms. Rojas. Some struggled with the pedagogy that includes teaching for understanding, focusing instead on teacher behaviors. And Ms. Passos struggled with a school culture that was especially resistant to change. The third broad theme in looking across cases relates to the school context as factor in how principals conceive of their roles in leading mathematics reform.

### **Principal Mathematics Leadership and School Context**

School context refers to the practices and beliefs of the school community – “a complex web of organizational structures, social networks and traditions” (Spillane et al., 2002).

School context emerged as an important aspect of principals’ sense-making about their leadership roles in mathematics reform. There were two findings related specifically to the important theme of the mathematics leadership role and school context. The first important finding relates to the demographics of the school including social class, language and ethnicity. These emerged as important factors in mathematics leadership. Second, the data highlighted how school infrastructure and culture for change became considerations in principal leadership for mathematics reform.

**School demographics and leadership for reform.** An analysis across cases revealed that challenges related to social class, ethnicity and home language of students were considered differently by each principal. While all three schools served predominantly Hispanic students, two of them (Tomasita and Sands) were also in very poor communities, with 100% of their students qualifying for free and reduced lunch. Tomasita and Sands both had large populations of ELLs. But Ms. Passos had spent several years at Tomasita as a teacher and an assistant principal, which enhanced her understanding of demographic issues. All three principals were truly dedicated to their work with diverse populations of learners, but realized the challenges. Mr. Torres indicated that students at his school and at nearby Sands were considered “the other side of the river” where families faced greater economic and social challenges, and schools were “underperforming.” Thus they were perceived by many as “less likely to succeed” (Mr. Torres, interview, 4/8/09). Mr. Torres was determined to not send Tomasita students on to middle school without strong skills in mathematics. “They won’t make it if teachers think they don’t have the skills” (4/8/09). He expressed a sense of urgency and will to better prepare students for success in mathematics, as that would protect them from the “double down, triple down” of tracking into remedial mathematics, remedial language arts, and “educational doom”. He modeled for teachers that he valued a personal connection with every student and every family by inviting parents to learn about standards, and welcoming them into the school. He embodied much of what Gutierrez, Bay-Williams, and Kanold, (2008) advocate to improve mathematics achievement by “developing and nurturing student, family, and community relationships” (p.1). He conveyed a sense of urgency about preparing students who had too often been “labeled as those dumb kids who don’t know math” (9/8/08) and thus relegated to remedial

mathematics and literacy classes. While frustrated that some of his teachers were slow to nurture mathematics relationships with students, as in the case of his teacher, Mr. M., Mr. Torres seemed to feel that most of his staff were aligned with his leadership.

Although her population was more affluent and her school had made AYP, Ms. Passos, too, was urgent about improving mathematics proficiency for struggling students in her school. She held a vision that “all teachers at a grade level share responsibility for struggling students to become proficient” (Interview, 6/2/09), echoing researchers Moss et al. (2008) who write, “Everyone in the district shares responsibility for successful learning by others as well as themselves” (p. 328). She struggled because of her school context. She was in a school that had always prided itself in successfully teaching mathematics to all students, indicated by meeting AYP. To counter the school culture of complacency, she used district policy for “every student at grade level . . .” to promote interventions for struggling students. However, Ms. Passos did not express urgency about meeting the needs of the small population of ELLs, who were achieving at only 14% proficiency in mathematics, because “there aren’t enough of them to even make a subgroup [for the accountability data].”

Ms. Rojas expressed more resignation to the idea that Sands students would not meet proficiency. She felt Sands students had little support at home, spent sleepless nights trying to rework the calendar and make adjustments to the school day to give students in her community more time at school. “I woke up at midnight with a new idea for the calendar” (3/11/09). Ms. Rojas aligned with many of her teachers in believing that the lack of success was due to the deficits in their home lives and their communities. This “framework of inequities” (Khisty, 1995) was expressed in comments like, “It’s the homes they come from.

Our kids come to us in kindergarten two years below grade level. We're playing catch-up" (9/7/08). So she hired a mathematics coach to support the teachers' struggle to "catch kids up", and she put her own efforts into extending the school day.

**School infrastructure and culture for reform.** The cross-case findings presented thus far have addressed how each principal had to navigate policies and a radical shift in mathematics instructional practices through the complexities of their schools. Two final sub-themes are discussed here: how principals conceived of their roles in designing supportive infrastructures for change and their roles in building a culture for change.

***Infrastructure for change.*** Scaling up mathematics reform requires structures "for creating possibilities for teacher" and thus student learning (Ball, 1994, p. 24). Research suggests that such an infrastructure requires organizational design that includes a stable and safe school environment; a focus on one major reform effort at a time; and access to resources of materials, time and expertise (Leithwood et al., 2004; St. John et al., 1999). All three school environments felt safe in terms of student safety. What differed between cases was safety and stability for staff to take on the challenges of reform mathematics. For the most part, Mr. Torres felt positive about his teachers' ability to form a learning community. He had a fairly stable staff, and had been able to hire several new teachers who had very collaborative ideas about learning mathematics pedagogy. Ms. Passos, on the other hand, was concerned that her staff was too stable. Many teachers had been at the school over fifteen years, and a culture of resistance to change had become entrenched. She struggled to make teachers feel safe to share their challenges with the reforms. For Ms. Rojas, instability of staff was her biggest challenge. She lamented that she had "so many new teachers" the second year of the implementation that she felt she was starting over. In fact,

she had struggled for some time “to get teachers to want to come way out here and work with this challenging population” (Interview, 2/27/08).

The second aspect of infrastructure for successful reform is a focus on one initiative at a time. The district’s singular emphasis on mathematics reform had only begun during the first year of this study, but that laser-like focus had an impact on the leadership of all three principals. All three principals reflected that they had just come out of an intensive district-wide literacy initiative and were concerned about moving the focus to mathematics. But as the study progressed, principals were clearly emphasizing mathematics as the focus of instructional improvement. Mr. Torres even stated that, “It’s up to me to emphasize math this year. Teachers know it’s what I’m looking for” (2/11/09). The second year of the reform initiatives, Ms. Rojas hired a mathematics coach in addition to her academic coach. Ms. Passos emphasized looking at mathematics in her efforts to unite teachers in looking at student work.

Another aspect of supportive infrastructure is access to resources. For mathematics reform, those materials include books, manipulatives, technology, preparation time and time to learn. Investigations and CMP materials were provided for every classroom, every teacher by the district. However, student materials were not provided in Spanish at any of the schools, and only Mr. Torres spoke of looking for a few books in Spanish. All three principals ensured that teachers had overhead projectors, transparencies and access to copying for student pages. They listened carefully to teachers who were implementing the curricula to learn what resources would be necessary. Related to time to teach and learn mathematics, each school had declared at least a 60-minute math block, with 75 at Sands. What principals revealed, however, was that they supported the district “balanced math”

framework, which allocated only 45 minutes for the reform curriculum lesson. Also, the principals all explained that often P.E. or other “specials” interrupted the mathematics block. They did not attempt to remedy the issue of only 45 minutes for the reform lesson. In fact, none of the principals in this study was concerned that the recommended minimum of 60 minutes for Investigations and CMP was consistent in every classroom.

***Building a culture of change.*** An important consideration related to school context when implementing change is the learning culture of the school (Leithwood, 2004; Remillard, 2005). School learning culture refers to understandings shared by teachers, administration, and students which structure their responses to demands made from outside and from within the organization. It was significant to note that the three principals described very different learning cultures related to the motivation and commitment of the school community to solve the complex challenges associated with mathematics reform. Ms. Passos, who articulated the most sophisticated understanding of the intent of the reforms, was the most constrained by her staff’s resistance to change. The school’s learning culture was to maintain the status quo. She was even concerned that new teachers with reform-minded ideas about mathematics teaching and learning may be “pulled to the dark side” in working with their grade-level peers who had been at the school for years. This made reform difficult.

Mr. Torres’ description conveyed a very different climate. He set the direction with a “can do” attitude toward improving student achievement, and he seemed to feel that teachers were on board. He, too, had resistant teachers, but the questions he fielded from teachers were more about what to change than whether to change. Ms. Passos, who had taught at Tomasita, confirmed this when she stated, “teachers got together to talk about



instruction!” The learning culture at Tomasita also included a “can do” belief that *all* Tomasita students could learn rigorous and relevant mathematics, including ELL and low-income students. In fact, in the short time Mr. Torres was at Tomasita, the number of ELL 6<sup>th</sup> graders who were placed in remedial mathematics in the 7<sup>th</sup> grade dropped considerably. Mr. Torres never talked about students from a deficit perspective. He knew all of their names, and became involved with their families through school social functions.

The school learning culture at Sands was more difficult to discern. Ms. Rojas stated on a number of occasions that her teachers “had to work extra hard because Sands students come in at least two years behind” (Interview, 2/7/08). She also affirmed her teachers’ concerns that students had no support for doing homework at home, so the mathematics homework was useless. Thus, Ms. Rojas focused her leadership efforts on creating more time at school, including after school tutoring and changing to a year-round calendar, rather than focusing efforts on improving mathematics instruction.

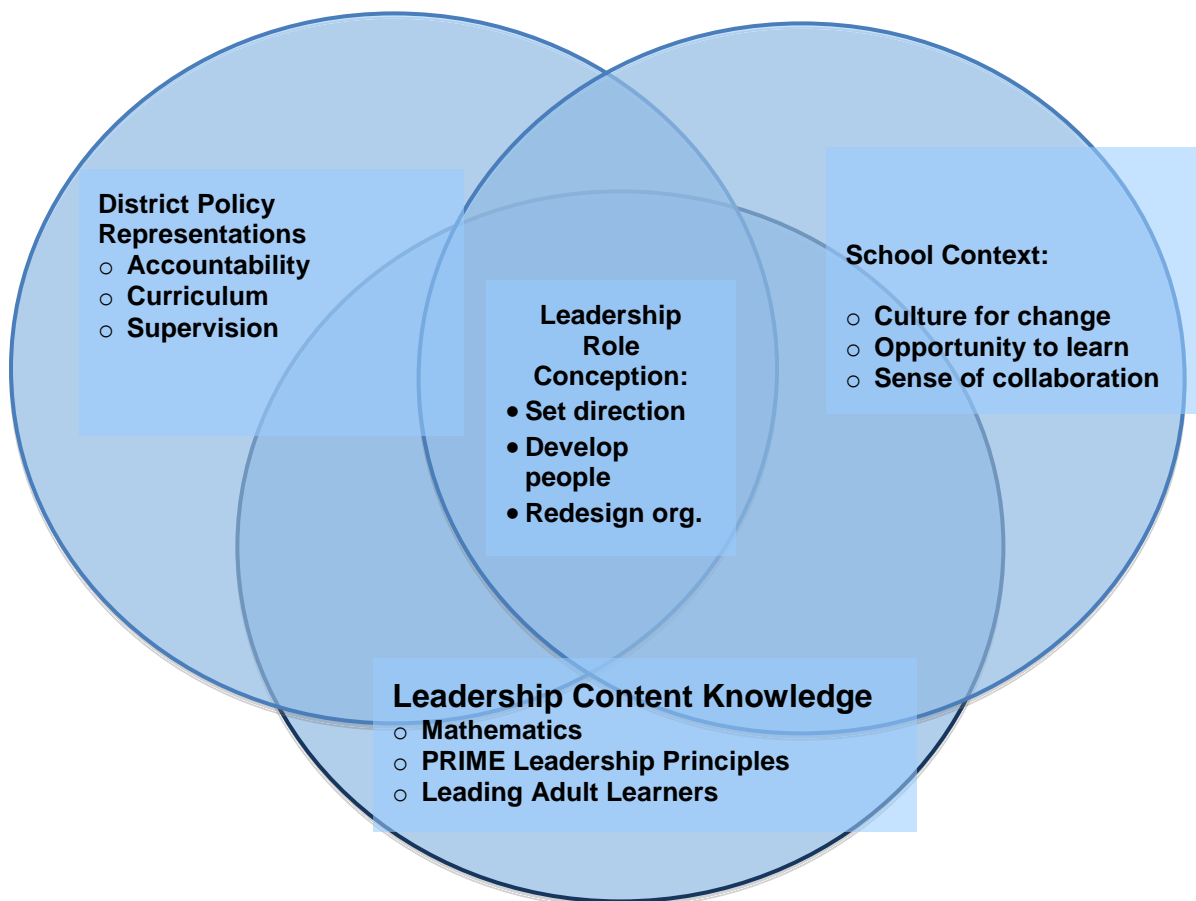
### **Cross-case Conclusions**

Although each of these principals received similar policy messages from the district related to the mathematics reform initiatives, they conceived of their roles and their ability to enact those roles very differently. The differences appear to be related to how principals interpreted the district policies through their leadership content knowledge and how principals’ conceptions of leadership were influenced by the school in which they practiced. A principal like Ms. Passos, with the sort of strong understanding of the problem-solving or inquiry approach to mathematics that is advocated by the reform movement, can be significantly challenged by the culture of the school. A principal like Mr. Torres, with strong agency for leading data driven decision-making can be challenged by a lack of

knowledge and understanding of the enormous paradigm shift that curriculum and pedagogical reforms mean for teachers.

This study provides a window into the conceptions of leadership held by three dedicated principals who sometimes “wake in the middle of the night” (Ms. Rojas) trying to find ways to meet the challenges at their schools. They come to their work with certain ideas, beliefs and understandings about what opportunity to learn entails, what high quality mathematics teaching and learning looks like, and what role they need to play in moving their school forward. Their stories remind us that principals are not uniform in their ideas, abilities, or beliefs, and that, in Ms. Passos words, “if we were all rolled into one, we would make one great principal!”

In sum, what this cross-case analysis highlights is the complexity of the principal’s role in leading mathematics reform. Principals’ ideas and understandings about how to lead teachers to improve teaching and learning were developed through a complex interaction of sense-making about the reform policies using what leadership content knowledge they had or had constructed. And their roles were influenced by the culture and norms within the schools that they lead. Figure 7.2, below, represents how three constructs intersect. It combines themes from the data related to district policies, to school context and to each principal’s LCK. The three domains inform each other in the development of principals’ conceptions of leading the reforms. Where the domains intersect is where the leadership role is enacted.



**Figure 7.2 Principal Leadership for Mathematics Reform, a New Construct**

This new construct incorporates what we know from the research in three areas: 1) leadership content knowledge (Stein & Nelson, 2003; Nelson & Sassi, 2005), which includes principals' beliefs, understandings and ideas about mathematics, the PRIME Leadership Principles (NCSM, 2008), and adult learning; 2) sense making about district policy for scaling up the reforms (Cobb & Smith, 2008; Spillane, Reiser & Reimer, 2002); and 3) sense-making about leading the reforms in the context of their unique schools (Spillane et al., 2002). There is evidence in this study that the influence of any one of the three factors may be greater or smaller for a particular leader. For Mr. Torres, district accountability policy supported both his experience and his ability to press teachers for improving mathematics teaching and learning. Because his LCK for using data to inform

instruction was strong, he drew heavily on district accountability policy to support his leadership efforts. Ms. Passos had strong LCK in both curriculum and reform pedagogy. She was able to take from district policy the representations she needed to support her ideas about reforming mathematics teaching. But she was hamstrung by the culture and traditions of the school. Ms. Rojas suggested that she and her teachers had learned that the policies were not enforced at her “remote location”, so she relied predominantly on her LCK and her teachers to improve mathematics teaching and learning. Because her LCK was weak, she was susceptible to teacher complaints about the problems with the curriculum, which resulted in Ms. Rojas abdicating responsibility for the reforms to her mathematics coach.

There is also evidence in these three cases that principals are attuned to the unique demographic, social, and language challenges in their schools, but that they are not able to articulate a vision for how to specifically address those challenges in mathematics teaching and learning. Setting direction for equity was articulated in the same general terms so often used in the reform policies themselves: “high expectations and strong support for *all* students” (NCTM, 2000, p. 12), and “ensure . . . access to meaningful mathematics learning for every student” (NCSM, 2008, p. 9), or “every student at or above grade level” (district mission, 2009). But in all of the interviews, there was little data to indicate principals’ conceptions of specifically *how* to work with teachers to create greater opportunities for low-income Hispanic students or ELLs to learn mathematics.

### **Summary**

The big themes that emerged across the cases fell into three general categories: 1) principals were brokers of mathematics reform policy; 2) principals’ LCK matters in their leadership of adult learners, both in supporting teachers and in holding them accountable for

new learning, and 3) how principals navigate mathematics reform within their unique school contexts varied greatly by school. The importance of the role of the principal is highlighted in these themes when considering how to improve mathematics teaching and learning at scale. The final chapter includes a discussion of the findings related to the important leadership role, as well as implications for further research.

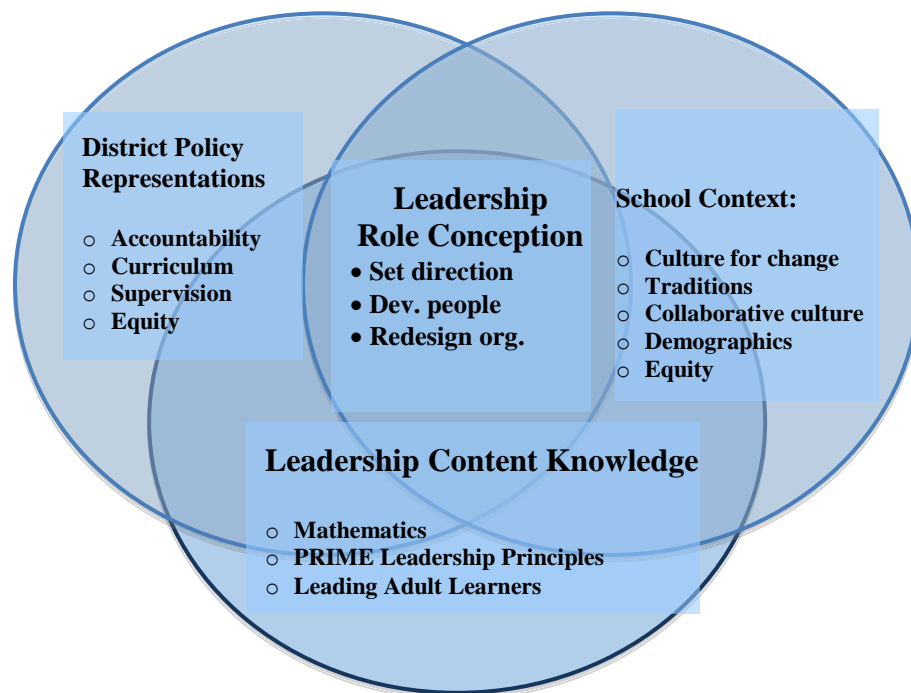
## Chapter 8: Final Discussion and Implications

The purpose of this study was to explore three principals' conceptions of their leadership roles in implementing mathematics reforms in their predominantly Hispanic-serving schools. The reforms were part of a district-wide initiative to improve student proficiency in mathematics and included the adoption of reform curricula that emphasized a problem-solving approach to teaching and learning. Since the first NCTM *Curriculum and Evaluation Standards* (1989), schools have been challenged to scale up mathematics reform efforts to ensure the success of all students (Cobb & Smith, 2008; NCLB, 2002). Principals, by virtue of their supervisory role, are critical to setting the direction for the reforms, for supporting teachers to learn the curriculum and the pedagogy of the reforms, and in aligning the school organization with the reforms (Leithwood et al., 2004; Lipsky, 1980; Nelson & Sassi, 2005).

The theoretical constructs used to frame the study blended a theory of principal sense-making with the construct of leadership content knowledge. The blended constructs provided a lens that was broader than that of the extant research on principal leadership related to mathematics teaching and learning. This research expanded the lens, bridging policy and practice. The study uncovered a number of new findings about how principals' beliefs and ideas about mathematics, teaching and learning, as well as their conceptions of policy and school contexts, influence the roles they assume.

In this final chapter, I summarize the findings from the individual principal stories and the cross-case analysis into several important new insights about the role of the principal in leading mathematics reform. To orient the principal role, I re-introduce the diagram (Figure 8.1) presented in Chapter 7 that portrays a synthesis of the cross-case

findings, indicating the complex interaction of a LCK, district policies, and school context on principals' role conceptions. The role of principal, which sits at the intersection of LCK, policy and school context, is the focus of the insights. Enactment of this role includes the three fundamental responsibilities discussed in the effective leadership research: setting direction; developing people; and redesigning the organization (Leithwood et al., 2004).



**Figure 8.1 Three Domains of Influence on Principals' Conceptions of Leadership Role**

Overall, findings from this study connected in significant ways to findings in the related empirical literature. The study also uncovered several new insights about how principals conceive of their part in improving mathematics teaching and learning in their schools. These insights are summarized below, in relation to the literature, in an attempt to give a comprehensive response to the question of how principals conceive of their leadership role in mathematics reform efforts.

## **New Insights**

**Insight #1: Expanding the construct of LCK.** When the construct of LCK is expanded beyond supervision of mathematics teaching and learning to include leading a community of learners in the PRIME leadership principles of equity, curriculum and assessment, a more comprehensive view emerges of the challenges principals face in leading mathematics reforms. The construct of LCK as presented by Stein & Nelson (2003) and Nelson & Sassi (2005) provides a basis for exploring principals' knowledge of the subject matter of mathematics as well as beliefs about how it is learned and how it should be taught. However, their research focused primarily on the Teaching and Learning Principle (NCSM, 2008), the process of supervision and the principal's role in recognizing and supporting the development of excellent instructional methods and did not include insights into the principal's role in curriculum implementation within their schools. Nor did their research address equity concerns. In this dissertation study, it became evident that setting the direction for the reforms, particularly in predominantly Hispanic-serving schools, would also require principals' LCK to include knowledge of the curriculum and classroom environments that promote opportunities for all students to learn rigorous and relevant mathematics. The importance of principals' conceptions of curriculum and equity was highlighted by an expanded construct of LCK that incorporated all of the PRIME Leadership Principles. The findings in this study also align with the extant research on effective instructional leadership that suggests principals must know something of the pedagogy they supervise in order to support teachers and to hold them accountable for new learning (Nelson & Sassi, 2005; Saxe, 2001; Stein, Hubbard, & Mehan, 2004). There are actually four aspects of this insight about the expanded LCK construct that emerged in this



study: principals' curriculum leadership is a critical aspect of LCK; principals conceive of a role that plays to their strengths in LCK; principals' LCK impacts their ideas about leading adult learners in mathematics reform; and principals are not afforded sufficient opportunities for their own professional learning to develop LCK.

*Curriculum leadership is a critical aspect of leadership content knowledge.* In a district-wide mathematics reform initiative that includes curriculum adoption, curriculum leadership was a critical aspect of leadership content knowledge. The adoption of two reform curricula was a significant part of the district's reform efforts. This emphasis on curricula mirrors the efforts of many districts nationally to initiate change in mathematics teaching by relying heavily on revised curricular materials (Ball & Cohen, 1996; Remillard, 2005). The Investigations and CMP2 curricula and implementation varied considerably from previous more conventional textbooks used in the district. Research on mathematics reform initiatives that have resulted in improved student achievement demonstrate the importance of instruction that weds strong curriculum with strong pedagogy (Ball, 2004; Shulman, 1987; Spillane & Zeuli, 1999). This research implies that LCK must include deep knowledge of the curriculum. The three principals in this study, however, varied in their knowledge of the curricula, and their leadership content knowledge related to the curriculum impacted how they conceived of setting the direction and supporting teachers in implementing the reforms. Of the three principals, only Ms. Passos claimed to know something of the curriculum, yet even her comments suggested misconceptions about the comprehensive design (for example, her idea that teachers needed only 45 minutes for the CMP or Investigations Lesson.) Each of the three principals expressed a vision that at some point all of their teachers would implement the adopted curricula, but none indicated that

they conceived of how that might occur. They did not supervise for curriculum fidelity, particularly with those teachers whose students were proficient. In addition, they did not seem to conceive of the significant challenges that learning the new curriculum entailed for teachers.

***Principals tended to conceive of a leadership role that played to their strengths.***

The three principals varied widely in their LCK related to mathematics teaching and learning, which impacted how they conceived of leading the reforms in their schools. While Mr. Torres and Ms. Passos both expressed confidence in their knowledge of mathematics and effective pedagogy, Mr. Torres played to his strength in teaching and focused more on teacher moves to engage students. Ms. Passos played to her strength in problem-based formative assessment and focused teachers on looking at student work. Ms. Rojas had little confidence in her knowledge of mathematics and in any of the PRIME leadership areas and thus did not conceive of her own involvement as an instructional leader in mathematics reform. She hired a mathematics coach to provide support and direction. She spoke of her role as enacted outside the classroom, focused on structural changes that would provide more time for students to be at school.

***Principal LCK impacted their ideas about leading adult learners in mathematics reform.*** Although not a new insight, this study reinforced previous studies on principals' mathematics LCK (Nelson & Sassi, 2005; Reed et al., 2006). Findings indicated that none of the three leaders conceived of a role in leading a community of adult learners that included targeted, sustained, practice embedded professional development. The research on teachers and mathematics reform efforts strongly emphasizes the challenges for teachers as they make a significant shift in the very ideas about the teaching and learning of

mathematics (e.g. Ball & Cohen, 1999; Cobb, Wood & Yackel, 1990). An important aspect of effective LCK is leading adult learning in adopting the reforms (Stein & Nelson, 2003). Teachers require substantial support in learning to use new curriculum materials (Remillard, 2005). “They need to learn about content, goals, approaches, and underlying assumptions of the curriculum they are being asked to use” (p. 239). A number of researchers have gone on to say that teachers need opportunities to examine new curriculum and practices with colleagues, discussing interpretations and implementation practices (e.g. Ball, 1996; Drake & Sherin, 2002; Remillard, 2005). Interestingly, none of the principals conceived of a significant role in developing teachers’ abilities to make the paradigm shift to a problem-solving curriculum and pedagogy. They hoped teachers would do this in their weekly collaborations, but they did not participate with teachers to ensure those conversations occurred. Their own leadership role was “loosely coupled” (Elmore, 2000) with classroom instructional practices, and thus decisions about what should be taught appear to have resided in individual classrooms. This was reflected in principals’ comments that some teachers were using the curriculum, and others were “doing what they had always done”. Additionally, all three principals reflected a lack of understanding of the significant professional supports needed for teachers to acquire the deep curricular understandings necessary to implement Investigations and CMP2, stating, “I need my weaker teachers to start using Investigations” (Mr. Torres, Ms. Passos) and “Teachers have to use Investigations in summer school. That way they have to learn it” (Ms. Rojas, interview, 6/2/09).

*Principals did not have opportunities to develop LCK for mathematics reforms.* In her research with 40 school administrators, Nelson (1998, 1999) found that principals often

had only a superficial understanding of the mathematics lessons they were supervising, causing them to focus on superficial aspects of instruction. In the reform initiatives in this study, the Las Palmas district made only minimal efforts to help principals develop knowledge of the curriculum and the pedagogy inherent in the reforms. Each of the three principals reflected on her/his own understandings of mathematics, teaching and learning based on past experiences as teachers, and from the bits and pieces each had picked up from observing in classrooms. Even Ms. Passos, who had attended some of the initial teacher trainings on the new curriculum materials, indicated that she had not figured out how to scale up implementation at her school. While they were expected to monitor for curriculum fidelity, balanced mathematics, and effective mathematics instruction, there was no structure for them to develop their supervisory knowledge related to the leadership principles.

**Insight #2: Observation checklists may be counterproductive.** A supervisory “walk-through” checklist, such as the one promoted by district policy, may be counterproductive to effective supervisory practices that promote reform. The Las Palmas district adopted the walk-through checklist as a way to promote instructional leadership and to give teachers immediate feedback about their instructional practices. The intent of the three or five-minute walk-throughs was to relieve some of the time constraints that prevented principals from getting into classrooms more often (Downey et al., 2004). For instructional change as complex as mathematics reform, the checklist proved insufficient, and in Ms. Passos case even counter-productive, because it tended to focus principals on the superficial aspects of reform, rather than on the intended and the enacted curriculum or observing for student understanding. Spending 3-5 minutes in classrooms did

not result in principals' ability "to determine the content of student knowledge and to identify curriculum objectives" (Downey et al., 2004, p. 23).

**Insight #3: Principals are brokers of policy messages.** As Remillard (2005) explains in her examination of research on curriculum use, districts often initiate regulation of mathematics teaching practices "in response to the failure of schools to raise student achievement levels, particularly for students of color and from low-income communities" (p. 211). So it was in the Las Palmas district. There were several policies intended to raise student achievement, including accountability policy, curriculum policy, and supervisory policy. In this study, it became evident that principals brokered district policy messages based on the strength of the message and their own LCK. District policies aimed at regulation, such as a uniform curriculum, supervisory checklists, and short-cycle accountability measures, were interpreted and implemented differently by each principal. Three aspects of the policy messages seemed to matter: the strength of the policy message; the clarity of the policy message; and the principal's knowledge related to the policy.

Similar to what education policy researchers have learned (Leithwood et al., 2004; Spillane, 2002), accountability policy messages in the Las Palmas district were explicit and carried significant and public consequences for principals and schools. The message to improve student proficiency on state assessments was reinforced by federal NCLB (2002) legislation. There was great similarity in the leadership focus each of the principals placed on improving assessment scores tied to accountability measures. How each principal helped teachers to make sense of the data to inform their teaching, to discern teaching gaps, and to integrate SBA and MAP data with classroom formative assessments depended on two skills: her/his agency with data-drilling and data-driven decision-making; and her/his depth of

understanding of formative assessment to guide mathematics instruction. Mr. Torres, “the data guy,” felt very adept in his understanding of short-cycle assessments. It was as though he was “top heavy” in this skill, and the accountability data became the substance of mathematics conversations in his school, much as Coburn and Russell (2008) predicted in their research with curricular reform. He made no reference to ongoing classroom formative assessments to guide mathematics instruction. Only one principal, Ms. Passos, had significant LCK related to formative assessment, and she encouraged teachers to look more closely at classroom data, including student work, to learn about how to adjust their teaching to meet student needs. Ms. Rojas demonstrated the strength of the district’s accountability policy message because she conveyed that she was not strong with data-driven decision-making. Thus she depended on the templates and proficiency requirements provided by the district both to interpret the success of her teachers and to present data on student achievement in mathematics.

Because accountability policy was so heavily emphasized, measurable and public, it trumped other reform-related policies that were more equivocal. Curriculum policy, which included the expectation that all teachers would implement the adopted reform curricula, was ambiguous and much more difficult to measure. It was ambiguous because other district messages about mathematics reform contradicted full implementation, such as the introduction of two other mathematics programs, and a balanced mathematics framework that did not include sufficient time for curriculum lessons. More importantly, implementation was difficult to measure. It required deep knowledge of the curriculum for supervisors to determine whether teachers were fully implementing it as intended (Remillard, 2005). Additionally, researchers have found that instructional leaders must

“understand new practices in a deep enough way to judge the quality of enactment in classrooms” (Stein, Hubbard, Mehan, 2004). Without the curriculum aspect of leadership content knowledge, principals could not distinguish the intended from the enacted curriculum. As Mr. Torres noted, if principals reported that 60% of their teachers were using the curriculum, it did not mean full implementation. Curriculum adoption without systemic attention to the support and guidance that aligns teaching practices with the intended curriculum implementation has not been successful (Briar & Resnick, 2000; Cobb & Thomas, 2008). The principals in this study were unable to conceive of a role in designing learning experiences for teachers to create a bridge between their existing conceptions and those that were required to implement the curriculum.

**Insight #4: School context impacts principals’ conceptions of leading reform.** In considering principal sense-making about implementing the reforms within the social and organizational structures of their schools, this study found that context can significantly impact principals’ conceptions of their leadership roles in mathematics reform. The three schools in this study shared some common demographics and infrastructure, but the varied institutional structures and relational structures (Spillane, 2005) impacted each principal’s ideas about the reforms. Institutional structures refer to normative ideas that organize how people in the organization interact with one another – roles, positions and expectations. The relational structures refer to the interconnections and interdependencies among people. All three principals conceived of similar institutional structures, including weekly grade-level collaboration, or PLCs, and the provision of materials. Where they differed was in their conceptions of relational structures and their ability to navigate the reforms within those structures. Mr. Torres seemed to feel “in charge” and able to assume a leadership role with

his teachers. He mentioned many times how they came to him with questions and for advice related to mathematics teaching. He spoke of the challenge of building a collaborative community, as “some teachers don’t play well with others.” Ms. Passos, on the other hand, suggested that her teachers had a lot of power and were very resistant to change. They had connections to board members and could create distress in the school if unhappy. She had a number of teachers who continued to operate from an instrumentalist, procedural paradigm. Although she was the leader with the strongest LCK, relational structures in the organization made it difficult for her to hold teachers accountable for changing their teaching practices and accepting the reforms. She even feared new teachers could be impacted by the strong negative voices of some of her veteran teachers. This social context caused her to rethink her approach to leading instructional change.

An interesting insight related to social context and interdependencies was the evolution of principals’ thinking about their involvement in collaboration or professional learning communities (PLCs) related to mathematics. Both Mr. Torres and Ms. Passos spent the first two years of the reform efforts believing that their academic coaches should facilitate the PLCs because “our presence intimidates the discussion.” But after they attended a training in PLCs and also recognized that they were not impacting teaching at scale in their schools, they began to talk about participating actively in the PLCs, and in the final focus interview of this study (6/2/09), they decided to do so the following year.

**Insight #5: Equity leadership is difficult to capture.** This study was purposively set in predominantly Hispanic-serving schools in order to contextualize principal leadership and mathematics reform in settings where little research had been done. NCSM (2008) claims that mathematics education leaders “are responsible for ensuring that



underperforming student populations are identified” and that teachers are provided with “resources, structures and accountability to address the identified gap in student achievement and identified gaps in the curriculum” (p.10). Yet this study found that leadership for equity in mathematics teaching and learning was the least articulated and least focused of the leadership principles. Principals leadership for equity in mathematics instruction focused more generally on having teachers provide interventions for individual struggling students and on identifying teaching gaps in the general student data. It also focused on expectations of making mathematics relevant and engaging for students. There were only occasional references to more specific pedagogical concepts such as classroom discourse and the language of mathematics. There was no indication that principals had considered how to support teachers in improving classroom practices that invited all students into the world of mathematics. Nor was there data to reflect how these principals held teachers accountable for these aspects of pedagogy.

**Insight #6: Principals Valued Reflection in Focus Interviews.** An unexpected insight from this study was that findings from the focus interviews indicated principals valued opportunities to talk with their peers about the work of leading reform. The focus group interviews were intended as a part of the data collection in the research design. Reflecting on the findings across the three cases, I discovered that principals were very dynamic and reflective during the focus interviews. They even commented at the end of two of the focus interviews (2/10/09 and 2/11/09) that, “We should get together like this more often.” The insight here is that principals were rarely afforded an opportunity for the very sort of collaborative professional development that research had found to be so critical for the improvement of teaching practice (e.g., Ball & Cohen, 1999; Coldron & Spillane, 2007;

Ellis & Berry, 2005). Principals, too, were learning about the reform curricula, about the demands on teachers, and about how their school organizations needed to work to support the reforms. Research supports the idea that school leaders need opportunities to extend and up-date their own pedagogical content knowledge (Spillane et al., 2004; Stein & Nelson, 2003). It is no longer helpful to assume that only classroom teachers need to learn about the teaching and learning of mathematics.

### **Implications**

This study has implications on for both practitioners and researchers. The three principals were selected not because they were remarkable, but because of their school contexts and their willingness to let me into their professional lives. They were intentionally “ordinary”, a representative sample of principals in many high poverty, predominantly Hispanic-serving schools across the southwest. Because they are not extraordinary, but dedicated and invested in student achievement, this study may be generalized to suggest directions for district leadership and for future research in mathematics reform related to the interconnectedness of the three areas of policy, LCK, and school context.

**Implications for district leadership.** As districts look to improve mathematics teaching and learning for all students in all classrooms, they must consider the important role of the principal in leading the efforts within their schools. This study suggests that there are four key aspects of principal leadership to address in mathematics reform efforts: 1) principals are brokers of policy within their schools, and they interpret and enact policy representations based on what they know of the reforms, their beliefs about mathematics teaching and learning, their beliefs about equity, and how they navigate the unique context of their schools; 2) principals, like teachers, are learners who need opportunities to construct

understanding and knowledge about the reforms; 3) principals, as leaders of adult learners, must understand how to work with the community of teachers in their schools to promote a collaborative culture of inquiry; and 4) each school presents its own unique set of circumstances and challenges to the reform efforts which principals must navigate.

Accountability policy is mandated with the force of NCLB behind it. It is easily articulated and easily measured. If standards-based curriculum implementation and problem-solving teaching pedagogy are the intent of district reform efforts, as well, district support must go beyond simply purchasing the curricula for all schools. Each of the principals in this study received the same policy messages, yet as implementers of policy, they conceived of their roles somewhat differently. The most obvious example was policy related to curriculum implementation. First, examination of the curriculum policy messages through the eyes of three principals indicated that the messages were ambiguous. If the adoption of a reform curriculum was intended to reform teaching practices in all schools, principals did not translate that to supervisory practice. Looking more deeply at principals' conceptions of curriculum implementation, we see that they did not have the foundational understanding of the intended and the enacted curriculum to set a direction for teachers to implement, and to support them in doing so.

A second implication that was a whisper at the beginning of this study, and became a drum beat throughout the last months, was that much of the research about the need to support teachers as learners can be applied to principals. If districts want to improve mathematics teaching and learning at scale, they would do well to provide principals with a balanced program of professional preparation to support them in leading mathematics reform. The same deep, ongoing, collaborative support that teachers need to make

significant changes in mathematics pedagogy is also essential for principals. In order to set the direction for mathematics curricular and pedagogical reform, they must have opportunities to develop their own knowledge and understandings about teaching and learning in a problem-solving classroom (Ball, 2004; Nelson & Sassi, 2005; Spillane, 2000). To effectively focus the learning culture in the school, to understand effective instruction in diverse classrooms, and to effectively supervise teachers, principals must be able to discern differences in the intended and the enacted curriculum, understanding both the forms and functions of the reforms. They must understand how curriculum implementation involves “a dynamic interchange between teacher and curriculum, agent and tool” (Remillard, 2005, p. 222). Principals need to know something about how students learn mathematics and what can be learned from student misconceptions in order to know what they are seeing in classrooms and to guide teacher change. They need to understand the teacher’s role in an inquiry based classroom – otherwise they will focus on superficial characteristics like manipulatives, word walls and small groups. Principals must have opportunities to discuss, dissect, explore and reflect on classroom observations with both their teachers and with other principals who are also learners.

Beyond expanding their own leadership content knowledge in mathematics, principals must also know how to lead adult learning communities in making major shifts in classroom instruction that challenge many traditional paradigms. Principals need to understand something about the challenges mathematics reforms hold for teachers, including the mathematics, the curriculum, and the pedagogy. They must find ways to provide ongoing, practice-embedded professional development, as well as build collaborative professional communities based on trust and inquiry. And they must know

enough about what best practices look like in the classroom to hold teachers accountable for implementing new learning. Principals require support and training in order to conceive of this role.

Finally, this study suggests that the school context, including demographics, history and culture, influence how principals conceive of leading mathematics reform. Push-back from staff and community can be strong, and reform can be threatening. Beliefs about who can learn challenging mathematics can be difficult to expand. Developing school and classroom social structures that invite all students into the world of mathematics problem-solving requires building a common vision and substantial collaborative work. Principals can play a key role in re-designing systems and building a learning culture that improves mathematics teaching and learning in all classrooms for all students in their schools.

**Implications for future research.** New questions are raised by this study. First, there are significant time considerations in overseeing a successful school-wide implementation of mathematics reforms. There are conflicting demands between the context in which principals currently work and the conditions that would make them stronger instructional leaders. Administrative duties must be balanced with learning leadership. How will the existing workload of principals be re-prioritized to allow for a greater focus on mathematics teaching and learning?

This study also only began the conversation about principal leadership and equity in mathematics teaching and learning. The site chosen for the research is a beginning, contextualizing the findings in predominantly Hispanic-serving schools. But there remain questions about how principals set the direction of mathematics reforms with attention to mathematics discourse, language of instruction, relevant curriculum, and educators' beliefs

about Hispanic students' capability to be successful in mathematics. We need theories about mathematics equity leadership that are grounded in knowledge and dispositions. We need a better understanding about how leadership is coupled with opportunities for teachers to explore the complex issues that surround equity and opportunity to learn mathematics.

Finally, this study has implications for research on policy. It appears there is also intended and enacted policy related to mathematics reform and improving mathematics teaching and learning at scale.

### **Revisiting the Researcher Role**

It has been important for me to recognize my role in this study, to recognize that I approached the research wearing two hats – that of a researcher, and that of a recently retired school principal. In the end, this dual role enhanced the study, as it brought together research and practice. The blending of roles also inspired the more expansive view of this study, to include multiple aspects that influence the role of leadership in any reform effort. Having been a practicing principal, I will always see questions of content-focused instructional leadership as imbedded in the larger context of the role, including school context and district policy.

It was also necessary to consider my role in order to address issues of perspective and trustworthiness (Creswell, 2007). My credibility as a researcher was contingent upon the participants' acceptance of me as a partial insider with sufficient experiential knowledge to understand the system and the mathematics. My own experience as principal at a school with similar demographics and challenges helped to enrich and deepen the interview exchanges. However, in writing up the analysis, I had to beware my dual identity as mathematics education researcher and principal in order not to foreground my own

perspective. Although the principals and I had much in common, I was interested in their conceptions and their unique ideas about their leadership role.

During the course of the study, I assumed the role of participant observer during professional development activities for teachers and for principals. I was a knowledgeable other for the lesson study teams at each school, and I attended several teacher and principal professional development sessions. I also assumed the role of facilitator of professional development training for principals called *Lenses on Learning*, modeled after the mathematics leadership research of Nelson (1998), Grant et al. (2003), and Nelson & Sassi (2005). This participation helped me to understand more about district guidance and support to schools in implementing the reforms, as well as to observe principals' responses and interactions.

### **Limitations**

This research is limited by the fact that it represents only a small sample of principals, and therefore is not generalizable. However, it does provide insights into what principals value and pay attention to in their leadership roles related to mathematics. Also, although the sample was small, I note that these principals were not identified as extraordinary, and therefore they are more likely represent a large majority of principals who struggle every day to try to improve their schools.

The role of researcher may have been an influence on how principals perceived their roles over time. My presence as a researcher, asking questions about mathematics teaching and learning in order to prompt reflection, may have caused the principals to pay more attention to their leadership roles in mathematics, thus impacting their practice and their ideas. For example, principals' responses the first time a question was posed about English

Language Learners in the mathematics classroom indicated that it was the first time two of the principals had really confronted the idea. Their lack of response became data, but the question triggered thoughtfulness on their parts that may have spurred new attention to the issue. The next time a question about ELLs in the mathematics classroom was posed, Mr. Torres elaborated more on his thinking about language of instruction.

Finally, this research is limited by the fact that the data reflects “snippets” of information, during isolated windows of time. A principal’s day-to-day decision-making and leadership behavior is the true indicator of his or her deeply held conceptions of the leadership role. This study and the analysis of the findings attempted to capture and interpret isolated data and put each “snippet” into the larger emerging themes to form a picture of what it is that principals find challenging and what they see as the possibilities in this complex role. As districts and states raise the bar on student achievement, principals are expected to manage complex change such as reform mathematics.. How principals conceive of their role in leading mathematics reform can help inform districts about the kinds of supports principals may need to become most effective in improving mathematics achievement for *all* students.

In spite of the limitations, I believe that both my own experience and my methodology provided qualitative integrity for this research. The voices of the principals provided valuable insight into what is important to consider as districts continue to press school leaders for greater accountability for improving student achievement in their schools. To reflect those voices accurately, it has been my intention to use impeccable qualitative methods to provide rich data to inform the educational community about what is both



possible and challenging for principals as they attempt to support best practices in the teaching and learning of mathematics in predominantly Hispanic-serving schools.

### **Closing Remarks**

The scope of this study was broad. My own experience as an elementary school principal taught me that the scope of school leadership is broad, and in considering the challenges of mathematics reform, a leader must consider her/his beliefs about both instructional change and cultural change. Recent research focused on leadership for improving the teaching and learning of mathematics has emphasized that principals' ideas about high-quality mathematics instruction and how they can support it "are significantly influenced by their own ideas about the nature of mathematics, teaching and learning" (Nelson & Sassi, 2005, p. 175). This study adds to the literature by considering how principals must combine their conceptions of mathematics teaching and learning with their role as broker of district policy and as a member of a school culture.

What my research offers is not an answer to best practices in mathematics leadership, but insight into where principals are in their own journey in exploring their own conceptions and challenges: What do I know and believe about mathematics teaching and learning that affords all students the best opportunities to become proficient and successful? How do I set the direction for the mathematics reforms within my school community? How do I broker the policy messages from the district in order to meet the needs of our students? What if I could consider these challenges with a cadre of my peers who are facing the same challenges?

And so I conclude with the hope that I have carried on the conversation about leadership in improving mathematics teaching and learning that invites all children, and

particularly those who have traditionally been underserved. I hope I have caused the reader to think about the important role of leadership in scaling up mathematics reform into all classrooms, so that all students have access and are invited to be a part of a community of learners excited about the challenges and beauty of mathematical problem-solving. I hope I have caused the educator to ponder the implications of leadership and the importance of developing instructional leaders able to negotiate the most effective practices in their schools. And I hope to have caused the researcher to plan a further investigation of the processes that occur when one asks: What is the role of principals in leading mathematics reform so that all students are successful?

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**Appendix A**  
**Principal Interview Questions**  
**and**  
**Focus Interview Questions**

### **Preliminary Interview Protocol – Principal**

*Interview #1 – October 2007*

*Name* \_\_\_\_\_  
*Date*

\_\_\_\_\_

Questions to help with my research on principals' perceptions their leadership roles in the implementation year of a new reform mathematics curriculum.

#### Guiding Questions:

- How many years have you been in education?
  - Teacher, including grade levels, subjects, and student populations
  - Principal
  - Other administrative or leadership positions
  
- Number of years as an educator in the Los Lunas Public Schools?
  - Roles/positions
  
- What is your level of formal Education?
  
- What other professional and personal experiences do you think have contributed to your thoughts about mathematics teaching and learning?
  
- How would you describe the culture of your school?
  - To what extent does the culture of this school support mathematics teaching and learning?
  
  - What changes do you think are needed, if any?
  
- Tell me your thoughts about how mathematics is learned by students in grades 5-8?

- Tell me your thoughts about how mathematics is taught or should be taught at the middle school level.
  
- Describe the leadership practices that currently exist at your school, particularly practices related to the teaching and learning of mathematics.
  
- As principal, what do you see as some of the benefits of this new curriculum for mathematics?
  
- What will be some of the challenges?
  
- How significant is the principal's role in this implementation year of CMP?
  
- When you observe mathematics in your school's classrooms, either formally or informally, what do you expect to see teachers doing? Why?
  
- What do you expect to see students doing? Why?
  
- Describe a great mathematics lesson.
  
- This study is being done in the Center for Mathematics Education of Latino/as. What are your thoughts on the role of language and culture in the teaching and learning of mathematics.
  
- Tell me about the most significant aspects of your school's leadership - formal and informal- that you think will sustain CMP2, including if you or central administration leave.

- How do you see parental involvement in mathematics reform in your school? In your district?
- How would you describe or explain CMP2 to a new parent coming into your school?
- How would you describe a supportive learning community for staff, students, and parents, and how would you promote such a community in your school
- What is the instructional vision for mathematics at this school, and to what extent does a shared vision exist?
- What considerations do you take into account as far as gender, language, culture, mathematical understanding, classroom practice. . .

Can you think of anything else you would like to add, thinking about leading the way in the implementation of a new and exciting mathematics curriculum?

*Interview #2 – February 2008*

Name \_\_\_\_\_

Guiding Questions:

Date \_\_\_\_\_

- I enjoyed our visit to classrooms. What have been your thoughts about what you observed on our walk-throughs?
  
- One of the things you talked about was wanting to see students working in small groups. I have a three-part question about that:
  1. What is the purpose of small group work in mathematics?
  
  2. How do you think groups ought to be configured?
  
  3. A colleague who is working with some Los Lunas math teachers as a Lesson Study coach told me that he asked teachers about how they configure their groups. They mentioned gender and mathematics ability/level, but not language ability. What are your thoughts on this?
  
- So, what's been happening in your school in the past two months to support the implementation of CMP?
  - How are teachers responding to the program?
  
  - What have you heard from students and parents?
  
  - How do you, as the principal, facilitate or play a role in what is happening?
  
  - What are some challenges that the mathematics program has brought?
  
- Would you consider your teachers practices to be highly privatized or very collaborative with regard to the teaching and learning of mathematics?



- After the recent MAP tests, what do you notice about student performance in mathematics? How will you talk with teachers about this?
- How do you use your Academic Coach with regard to the CMP program?
- What do you believe about fidelity to the program now that teachers have been using it for several months?
- The testing data shows a significant gap in the scores of ELL students and non ELL students in mathematics. In your view, what are the sources of the gaps in mathematics achievement between various groups of students at your school that you see in testing data?
- What would you like to see in the mathematics classroom that addresses culture and language?

The final set of questions is about the supervision and evaluation process.

- How does the supervision and evaluation process work in this school?
- How and why do you think supervision and evaluation contributes to the teaching and learning of mathematics in this school? *In this district?*
- How and why do you think supervision might impede the teaching and learning of mathematics in this school? *In this district?*
- Several principals have made a comment supported by research – that it is very difficult to find mathematics teachers. How does this fact impact your school and your students?

*Interview #3– September, 2008*

Name \_\_\_\_\_

Guiding Questions:

Date \_\_\_\_\_

1. What successes/challenges have you heard from teachers as they start the year and reflect on last year?
  
2. I am interested in capturing teachers' ideas about implementing the reform mathematics programs this year. I thought you might be, as well. What do you think about co-creating a survey that I would administer to the teachers (or the coach???) at a PD session? It would be:
  - a. Anonymous
  - b. For our eyes only
  - c. To help get a sense of the strengths/needs of teachers as a group
  
3. How will your teachers receive professional development this year?
  
4. How are bilingual teachers and all teachers addressing language in the mathematics classroom this year?
  
5. How many of your kiddos are going into Ramp-Up at MV this year?
  
6. How do you conceive of using data in improving mathematics achievement? For Latino/a students?

*Interview #4 December 2008*

Name \_\_\_\_\_

Guiding Questions:

Date \_\_\_\_\_

Open by sharing the current stage of my study.

- Now a dissertation study, not a pilot
- Will need new IRB forms
- How much I appreciate your help and dedication to your work. Are there any questions you have of me before we start?.
- Looking at all grades, Investigations and CMP

1. I'd like to start by reviewing some of the data I collected last year. In order to make sure that the information is correct, I want to clarify what I currently have documented.
  - Administrative experience
  - Teaching experience
  - Bilingual?
  - Is the term Hispanic or Latino used for your school population?
2. I am contextualizing the study to focus on principals' conceptions of Hispanic student achievement in mathematics, and ELL learners in particular. What have you noticed about your Hispanic students and ELL Hispanics in the mathematics classroom? What are your concerns, if any?
3. It is clear that data-driven decision-making is important in this district. Thinking about mathematics, how do you use accountability literacy in working with teachers to make decisions about student success and achievement?
4. Related to the data, how are your Hispanic students in general meeting proficiency in mathematics? ELL's? What is the principal's role in ensuring differentiated instruction and intervention for struggling students?

5. Trying to decide about Opportunities to Learn related to language and culture.
  - What is the role of culture?
  
  
  
  
  
  
  
  
  
  
  - What is the role of language?
  
  
  
  
  
  
  
  
  
  
6. How have you and your teachers used the Professional Development Plan (PDP) to address improving instruction in mathematics, particularly with the new curricula?
  
  
  
  
  
  
  
  
  
  
7. Share survey information on surveys. What do you notice from this survey information?

*Interview #5 Questions and Guidelines April 2, 2009:*

- I. Focus is on framework of Leadership Content Knowledge referencing attached schema. The graphic is designed to share with principals in the interviews, to elicit discussion. Questions designed to “get at”:
  - a. , with the inclusion of Accountability issues. Who is accountable for what at each level?
  - b. Opportunities to learn: Who provides the opportunities and to whom at each level?
  
- II. Share with principals the overarching concern about equity, referencing the following data. NAEP (2005) and SBA (should these be spelled out?) data show that Hispanic students are not achieving proficiency at the same level as white students.

NAEP data for New Mexico	Percent of students in NM schools	% Proficient or above at Grade 4	% Proficient or above at Grade 8
<b>White</b>	30	48	39
<b>Hispanic</b>	56	17	11

Questions for research participants in reference to both schema and table:

1. Some researchers call the above figures an achievement gap. Others prefer the term opportunity gap because it gives more of the responsibility to the schools. What are your thoughts about the achievement/opportunity gap?
  - 
  - What is the role of students? Parents? The principal? The district?
  
2. Looking at the framework, at the fourth level (District), what are the district’s What is your role?

Possible probes:

- What are the supports they offer principals?
- 
- 
- 
- Are there incentives? Training? Resources?

3. At the third level (Principals supervising and supporting teachers as learners), what do you perceive is your role in providing both the assisting teachers need to improve their teaching, especially to address Hispanic students?

Possible probes regarding the following examples:

- a. Lesson Study
- b. Professional Learning communities and opportunities to reflect on teaching
- c. Looking at student work

4. How do you perceive of your role in providing the press they need for continual improvement? What are the challenges at your school?

Possible probes:

- 
- How does curriculum fidelity fit here?

5. How would you like to participate with your teachers in professional development?
6. Thinking about your role at the second level (teaching and learning) of this framework what are your ideas about what should happen between students and teachers during mathematics instruction to improve opportunities for Hispanic students?

Possible probes:

- What do you look for in the classroom?
- Investigations and CMP are language based. What implications does this have for teaching your students?
- What are the most exciting things happening at your school in mathematics classrooms?
- What are the biggest challenges and biggest rewards?
- I know you have an observation checklist. What do you look for and how do you share your observations with teachers?

6. The Investigations and CMP authors say that many teachers do not have sufficient understanding of data & probability and 3-D geometry to teach the curriculum. What are your ideas about this?

7. How mightWhere do each of the following required documents or processes fit within the framework in light of creating greater opportunities to learn for Hispanics and ELLs?

- The EPSS
- Data-driven decision making
- Teacher Professional Development Plans

Possible Probes:

- What is your school's EPSS strategy for improving student achievement in mathematics?
- How have you and your teachers used data-driven decision making?



*Interview # 6*    *May/June. 2009*                      *Name* \_\_\_\_\_ *Date* \_\_\_\_\_

1. How many of your teachers had PDP's related to mathematics teaching and learning?
  
2. How are your teachers using the data from the MAP assessment? What if an ELL student did poorly on the MAP assessment, but the teacher knew that the student has deep mathematical understanding of fractions, decimals, geometry, number sense?
  
3. What does "data mining" mean to you in terms of improving mathematics achievement for all students?
  
4. What is your leadership role in:
  - a. Improving mathematics instruction?
  
  - b. The implementation of CMP and Investigations in every classroom?
  
  - c. Improving mathematics instruction specifically for Hispanic students and Latinos?
  
5. What are the biggest challenges of implementing the reforms?
  
6. What are the biggest challenges of improving student achievement in math?
  
7. Go over results of Teacher Surveys.



## Focus Group Interview Questions

### Focus Group Interview (#1)

Name \_\_\_\_\_

Date \_\_\_\_\_

### Math Leadership

1. How has your Instructional Leadership related to mathematics changed this year?
2. What is the role of principals and other school leaders in the math initiatives in this district?
3. Thinking about the mathematics curricula, CMP and Investigations:

What is going well?

- for you?
- For your teachers?
- For students?

What are the challenges?

- For you?
- For teachers?
- For students?
- For parents?

4. What support do you need as a leader of math reform?
5. Should all of your kiddos be in Algebra by grade 7?

6. What if you learned it was your ELLs and Hispanic kids who didn't?
7. Maybe not all kids go to Algebra by 7<sup>th</sup> grade, but isn't it odd that it is the poor Hispanic and ELL kids who don't? Why is that?
8. Do you get the sense that your teachers believe that all students can achieve? If not, what is leaders role in changing this?
9. What do you think of the idea that each lesson should have both language and content goals?
10. What do you believe to be the district expectations for math? For your leadership?
11. **Some question to get at the idea of what they would like from the district to help them to press teachers to implement reforms. Would they also like district support for teacher support in first principles?**

### **Teachers**

12. What support will teachers need in the future and where will it come from?
  - PDP
  - PLC's
13. Did any teachers have math as focus of PDP?

### **DATA**

14. What did you notice in the AP data related to mathematics?
  - Is there an achievement gap in traditionally underrepresented populations (poor, Latino, Ell, etc.)?
  - Is MAP broken down in subgroups?
  - Does data reflect any particular challenges for ELL's?

**Focus Group Interview # 2 (Pre CMP training)**

Date: 2/10/09 Names: \_\_\_\_\_

Re: Conversation Questions Pre-CMP training workshop in Michigan.

Questions to ask:

1. What do you hope to gain from attending the CMP training?
2. What are your biggest struggles/challenges so far?
3. How would you describe your role in interacting with teachers about the teaching and learning of CMP?
4. On a scale of 1 – 10, how would you rate your familiarity with the CMP curriculum? The Investigations Curriculum?
5. What does a “standards-based” curriculum mean to you? What role does the teacher have?
6. What is your role in professional development activities?
7. I notice there is nothing related to working with parents. Do you have questions here?
8. I notice that there is a session on instructional strategies for ELL and sp. Ed students. What do you hope to gain from this session?
9. Two interesting topics related to equity. Reaching ALL students, and Quest for Truth, Fairness, Justice and Equity. (last session). What do you want to know about these topics? Why are they listed?
10. What questions do you have regarding assessments? How do you feel about the way students are currently assessed?

**Focus Group Interview #3** questions for 3/11/09 (Post CMP trip)

1. Ask about vignette when M.S. teacher said, “These kids aren’t good at explaining their thinking”
2. There were a number of ELL students in the class. One boy, who was ELL never spoke much. How does the teacher assess?
3. What do you think of this?
  - What kinds of professional development do you feel your teachers need to support them in the implementation of meaningful problem-solving instruction for Hispanic students, especially those with a home language other than English?
4. Do any of your teachers have a PDP focus on math?
5. What are the Walk-Throughs telling you? How are they informing your leadership?
6. What do you call collaboration? PLC? How often do teachers address student work? Mathematics teaching and learning? Actually work on math problems?
7. In my research, I frame the principal role as facing three challenges in mathematics reform: The reforms themselves, including new ideas about teaching and learning, and new materials; accountability, and; equity.
  - Equity: What do your teachers really believe about teaching math to students with the challenges of your demographics?
  - Reforms: What are you noticing teachers implementing the new curricula?
  - Accountability: What, if any, is the connection between curriculum use and student proficiency?
  - What would you identify as the biggest challenges?

## **Focus Group Interview #4 June 2, 2009**

Preface:

In my research, I am focusing on what appear to be three big challenges for leading mathematics reform to improve student proficiency in mathematics. The following questions focus on the three general areas, which are:

- The reforms themselves, including both the curriculum and instructional pedagogy.
- Accountability and assessment demands to improve student proficiency in mathematics,
- Equity that addresses the gap between White and Asian students and Hispanic students proficiency.

### **Reform Mathematics - a paradigm shift**

1. It can take 3 years for full implementation. (Read them part of the letter from WA principal who implemented CMP). What do you think full implementation should look like?
2. What are the challenges to full implementation?
3. Some of you have said that 100% of teachers are using Investigations/CMP, but that it is not implemented with fidelity by all teachers. What does this mean?
4. What advice would you give principal just beginning to implement these curricula in their schools?
5. Here is a vignette of a whole class division lesson. (Give them a copy of the vignette.)/
  - What do you notice?

Possible probes:

- What is the big mathematical idea of this lesson?
- What would be your role with this teacher

### **Accountability**

1. How does the accountability system help you in your leadership role in improving student mathematics proficiency?

2. How does it hinder you?
3. What are the challenges of accountability?

Look at clip from Investigations lesson from Lenses on Learning tape: Fraction Tracks. The kids were trying to get to one. Probe questions:

1. What did you think of this lesson?
2. What would be the challenges regarding ELL
3. What kinds of professional development do you feel your teachers need to support them in the implementation of meaningful problem-solving instruction for Hispanic students, especially those with a home language other than English?

Give data charts from 6 schools from SBA math. Ask them:

1. What do you notice?
2. What do they think about this data?

**Appendix B**

**Las Palmas Schools K-6 Classroom Walkthrough Observation**

Las Palmas Schools <i>Every Student Every Year: At or Above Grade Level</i> K-6 Classroom Walk-through Observation Checklist							
Date: _____		Time in: _____ Time out: _____					
Teacher: _____		Grade: _____ Observer: _____					
<p style="text-align: center;"><b>Comprehensive Literacy</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> guided reading</li> <li><input type="checkbox"/> word walls (interactive)</li> <li><input type="checkbox"/> use of leveled library</li> <li><input type="checkbox"/> independent reading</li> <li><input type="checkbox"/> working with words</li> <li><input type="checkbox"/> student writing</li> </ul> <p>Connecting to reading:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> text to text</li> <li><input type="checkbox"/> text to self</li> <li><input type="checkbox"/> text to world</li> </ul> <p>Observed:</p>  <p style="text-align: center;"><b>Balanced Math</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> use of math manipulatives</li> <li><input type="checkbox"/> word walls (interactive)</li> <li><input type="checkbox"/> math vocabulary</li> <li><input type="checkbox"/> number literacy</li> <li><input type="checkbox"/> concept building</li> <li><input type="checkbox"/> students writing about their thinking</li> <li><input type="checkbox"/> Investigations</li> <li><input type="checkbox"/> CMP</li> <li><input type="checkbox"/> student application</li> </ul> <p>Observed:</p>	<p style="text-align: center;"><b>Differentiated Instruction</b></p> <p>The teacher offers different approaches to <i>what</i> students learn, <i>how</i> they learn it, and <i>how</i> they <i>demonstrate what they've learned</i>.</p> <p>The teacher differentiates for:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Content – <i>input, what students learn</i></li> <li><input type="checkbox"/> Process – <i>how students go about making sense of ideas and information</i></li> <li><input type="checkbox"/> Product – <i>output, how students demonstrate what they have learned</i></li> </ul> <p>Evidence of:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> the presence of a variety of instructional strategies</li> <li><input type="checkbox"/> large and small group instruction</li> <li><input type="checkbox"/> instruction that is clearly focused on learner needs</li> <li><input type="checkbox"/> modifications and adaptations for SPED students</li> <li><input type="checkbox"/> sheltered instruction for ESL students</li> <li><input type="checkbox"/> intervention programs taught with fidelity</li> <li><input type="checkbox"/> student to student interaction</li> </ul> <p>Observed:</p>	<p style="text-align: center;"><b>Standards-Based</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Power standard or essential question is posted.</li> <li><input type="checkbox"/> what is posted is what is being taught</li> <li><input type="checkbox"/> students can explain what they are learning and why</li> </ul> <p style="text-align: center;"><b>Data-Driven Classroom</b></p> <p>The teacher:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> checks for understanding</li> </ul> <p>Evidence of:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> student achievement data</li> <li><input type="checkbox"/> the teacher monitoring student progress</li> <li><input type="checkbox"/> exemplars of student work</li> <li><input type="checkbox"/> annotated student work</li> <li><input type="checkbox"/> running records</li> <li><input type="checkbox"/> flexible grouping of students</li> </ul> <p>Observed:</p>	<p style="text-align: center;"><b>Classroom Management</b></p> <p>Evidence of:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> a climate of mutual respect</li> <li><input type="checkbox"/> rituals and routines</li> <li><input type="checkbox"/> clearly understood rules</li> <li><input type="checkbox"/> a clear opening of lesson</li> <li><input type="checkbox"/> a clear closing of lesson</li> <li><input type="checkbox"/> smooth transitions</li> <li><input type="checkbox"/> clearly-stated instructional directions</li> </ul> <p>Approximate % Level of Student Engagement:</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 25%; text-align: center;">0</td> <td style="width: 25%; text-align: center;">25</td> <td style="width: 25%; text-align: center;">50</td> <td style="width: 25%; text-align: center;">100</td> </tr> </table> <p>Evidence students are:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> thinking</li> <li><input type="checkbox"/> listening</li> <li><input type="checkbox"/> actively participating</li> </ul> <p>Observed:</p>	0	25	50	100
0	25	50	100				



**Appendix C**

**Teacher Web-based Survey (Survey Monkey)**

1. Please indicate your grade level, years of teaching, and school		
	Response Percent	Response Count
a) K-2nd grade	38.9%	14
b) 3rd-6th grade	58.3%	21
c) 0-4 years	25.0%	9
d) 5-10 years	33.3%	12
e) more than 10 years	22.2%	8
f) DVES	36.1%	13
g) Tomé	25.0%	9
h) PES	5.6%	2
	answered question	36
	skipped question	0

2. To what extent is the mathematics curriculum at your school consistent with each of the following?					
	Not at all	To a small extent	To a moderate extent	To a great extent	Response Count
a) My personal beliefs about effective teaching methods	0.0% (0)	11.1% (4)	63.9% (23)	25.0% (9)	36
b) Ways of teaching	5.7%	20.0% (7)	40.0%	34.3%	35

mathematics promoted in professional development sessions	(2)		(14)	(12)	
c) Mission of your school	2.9%	8.8% (3)	52.9%	35.3%	34
	(1)		(18)	(12)	
	answered question			36	
	skipped question			0	

3. So far this school year (including last summer), how often have the following events occurred?

	answered question				36	
	skipped question				0	
					Rat	
	Not at	To a	To a	To a	ing	Response
	all	small	moderate	great	Av	Count
		extent	extent	extent	era	
					ge	
a) I have examined student mathematics work with other teachers.	30.6%	50.0%	11.1% (4)	8.3%	1.9	36
	(11)	(18)		(3)	7	
b) I have encountered significant behavior problems during mathematics lessons.	33.3%	44.4%	13.9% (5)	8.3%	1.9	36
	(12)	(16)		(3)	7	

c) I have analyzed student assessment data to determine what assistance students need.	0.0% (0)	11.1% (4)	50.0% (18)	38.9% (14)	3.2 8	36	
d) I have discussed mathematics teaching with the principal/assistant principal.	16.7% (6)	50.0% (18)	25.0% (9)	8.3% (3)	2.2 5	36	
e) I have attended professional development related to mathematics.	19.4% (7)	25.0% (9)	38.9% (14)	16.7% (6)	2.5 3	36	
Show replies	Comments:				5		
4. What are some major challenges of teaching Investigations/CMP at your school? (Please check all that apply.)							
						answered question	30
						skipped question	6
						Response	Response
						Percent	Count
a. Understanding and using the new curriculum.						43.3%	13
b. Covering all the standards in a school year.						73.3%	22
c. Lack of a teacher support network.						30.0%	9
d. Lack of time to teach math.						43.3%	13
e. Differentiating instruction						36.7%	11
f. Motivating students						50.0%	15

g. Working with ELLs	26.7%	8
h. Student behavior problems during math lessons	43.3%	13

5. Indicate any of the following you have discussed with another educator related to math. Please indicate in the comment box who you usually talk to about math-related issues.

	answered question	34
	skipped question	2
	Response Percent	Response Count
a. Classroom management for improving math instruction.	44.1%	15
b. Progress of ELL and Hispanic students.	64.7%	22
c. How to implement lessons from Investigations/CMP	70.6%	24
d. Pacing lessons.	58.8%	20
e. Understanding the math content.	32.4%	11
f. Student work.	50.0%	17
g. Assessment of students.	52.9%	18
h. Motivating students.	44.1%	15
i. Differentiating instruction.	67.6%	23
Show replies With whom do you talk about these issues? 25		

6. In what ways does your principal or assistant principal support your mathematics teaching?

(Any explanations of your answers in the comments box would be appreciated.)

	answered question	35
	skipped question	1
	Response Percent	Respon se Count
a. He/she provides regular time for teacher collaboration around mathematics teaching and learning.	31.4%	11
b. He/she discusses mathematics teaching with me.	17.1%	6
c. He/she discusses student math assessment, test data only, with me	45.7%	16
d. He/she discusses student math work with me.	2.9%	1
e. I have the instructional materials necessary to teach my class	74.3%	26
f. He/she provides me with feedback on what is observed during visits to mathematics lessons.	62.9%	22
g. I do not feel that I get enough support. (Please explain in comment box.)	8.6%	3

Show repliesComments 8

7. How often does your principal/assistant principal observe during a mathematics lesson, and

what kind of feedback do you receive?	
answered question	33
skipped question	3
	Respo
	nse
	Count
Show replies	33
8. If you were asked to observe another teacher's math classroom, what would you look for to decide if the mathematics instruction is high quality and the students are constructing mathematical ideas?	
answered question	33
skipped question	3
	Respo
	nse
	Count
Show replies	33
9. Is your view of high quality math instruction shared by all teachers in your school? Explain.	
answered question	33
skipped question	3
	Respo
	nse
	Count

Show replies	33
answered question	34
skipped question	2
	Respo
	nse
	Count
Show replies	34



**Appendix D**  
**Coding Sample LCK-Prime**  
**and**  
**Data Chart Sample**

## Coding Sample LCK-Prime

	<b>Subject Knowledge</b>	<b>Teacher ----- Student</b>	<b>Principal ----- Teachers</b>	<b>District ----- Adult Learners</b>
<b>Leadership for Equity</b>	<b>Equity&gt;Subject</b> <ul style="list-style-type: none"> <li>• E&gt;S&gt;L (language) <ul style="list-style-type: none"> <li>○ Language in home</li> <li>○ Language use in home</li> <li>○ Academic language</li> </ul> </li> <li>• E&gt;S&gt;Relevance <ul style="list-style-type: none"> <li>○ Lived experience</li> </ul> </li> </ul>	<b>Equity &gt; T/S</b> <ul style="list-style-type: none"> <li>• E&gt;T/S&gt;L (language) <ul style="list-style-type: none"> <li>○ Language of instruction</li> <li>○ Attention to language</li> <li>○ Academic language facilitation</li> </ul> </li> <li>• E&gt;T/S&gt;Expectations</li> <li>• E&gt;T/S&gt;privilege?</li> </ul> <p><i>How to express “attention to need?”</i></p>	<b>Equity &gt; P/T</b> <ul style="list-style-type: none"> <li>• E&gt;P/T&gt;training</li> <li>• E&gt;P/T&gt;Support</li> <li>• E&gt;P/T&gt;Expectations</li> </ul> <p><i>How to express “beliefs about relationship between parent bkgnd and know., language use, and student student perform.</i></p>	<b>Equity &gt; D/AL</b>
<b>Leadership for Teach/Learn</b>	<b>T/L &gt; Subject</b> <ul style="list-style-type: none"> <li>• T/L&gt;S&gt;relevance</li> <li>• T/L&gt;S&gt;Instrumentalist</li> <li>• T/L&gt;S&gt;Problem-Solver</li> <li>• T/L&gt;S&gt;Beliefs about teacher math knowledge</li> <li>• T/L&gt;S&gt;Beliefs about own math knowledge</li> <li>• T/L&gt;S&gt;affect (attitude as learner of mathematics)</li> </ul>	<b>T/L&gt;T/S</b> <ul style="list-style-type: none"> <li>• T/L&gt;T/S&gt;class management</li> <li>• T/L&gt;T/S&gt;stu engagement</li> <li>• T/L&gt;T/S&gt;relevance</li> <li>•</li> </ul>	<b>T/L&gt; P/T</b> <ul style="list-style-type: none"> <li>• T/L&gt; P/T&gt; teacher quality, hiring</li> <li>• T/L&gt;P/T&gt;expectations for teaching practice</li> <li>• T/L&gt;P/T&gt;PLCs</li> <li>• T/L&gt;P/T&gt;PD</li> <li>•</li> </ul>	<b>T/L&gt; D/AL</b>
<b>Leadership for Curriculum</b>	<b>Curriculum &gt; Subject</b> <ul style="list-style-type: none"> <li>• C&gt;S&gt;Relevance</li> <li>• C&gt;S&gt;Instrumentalist</li> <li>• C&gt;S&gt;Reform</li> <li>• C&gt;S&gt;Knowledge of Standards</li> </ul>	<b>Curriculum &gt; T/S</b> <ul style="list-style-type: none"> <li>○ Fidelity</li> <li>○ relevance</li> </ul>	<b>Curriculum &gt; P/T</b> <ul style="list-style-type: none"> <li>• C&gt;P/T&gt;Fidelity (Holding teachers accountable for implementation)</li> <li>• C&gt;P/T&gt;Supervision</li> <li>• C&gt;P/T&gt;PLC</li> <li>• Parents?</li> </ul>	<b>Curriculum &gt; D/AL</b> <ul style="list-style-type: none"> <li>• Curriculum &gt; D/AL&gt;fidelity</li> <li>•</li> </ul>

## Coding Sample LCK-Prime (continued)

	<b>Subject Knowledge</b>	<b>Teacher ----- Student</b>	<b>Principal ----- Teachers</b>	<b>District ----- Adult Learners</b>
<b>Leadership for Accountability</b>	<b>Accountability &gt; Subject</b> <b>A&gt;S&gt;Skills</b> <b>A&gt;S&gt;Concepts</b> <b>A&gt;S&gt;Formative</b> <b>A&gt;S&gt;Summative</b> <b>A&gt;S&gt;</b>	<b>Accountability &gt; T/S</b> <ul style="list-style-type: none"> <li>• <b>A&gt;T/S&gt;Expectations</b> <ul style="list-style-type: none"> <li>○ <b>MAP</b></li> <li>○ <b>RtI</b></li> <li>○</li> </ul> </li> </ul>	<b>Accountability &gt; P/T</b> <ul style="list-style-type: none"> <li>• <b>Acc &gt; P/T&gt;Map</b></li> <li>• <b>Acc &gt; P/T&gt;AYP</b></li> <li>• <b>Acc &gt; P/T&gt;formative</b></li> <li>• <b>Acc &gt; P/T&gt;standards</b></li> <li>• <b>Acc &gt; P/T&gt; cohort</b></li> <li>• <b>Acc &gt; P/T&gt;RtI</b></li> <li>•</li> <li>•</li> </ul>	<b>Accountability &gt; D/AL</b> <ul style="list-style-type: none"> <li>• <b>A&gt;D/AL&gt;Expectations</b> <ul style="list-style-type: none"> <li>○ <b>A&gt;D/AL&gt;AYP</b></li> <li>○ <b>A&gt;D/AL&gt;MAP</b></li> <li>○ <b>Walk-Thru</b></li> </ul> </li> <li>• <b>A&gt;D&gt;PD</b></li> </ul>

## Data Chart Sample

	Date	Line #	Key Word	Comment	Verbs
1	4/2/09	147A	AC accountability	There is accountability to the grade level. . .It's not up to the individual teacher. "Oh, he didn't get 'define and identify qualitative data! What can I do now?" (asking the grade level about interventions).	
2	4/2/09	189B	AC accountability P press	Walt always wanted her gone (because of her students' low scores). We showed him her scores, saying 'she's really stepped up', and he just couldn't believe it.	We showed him
3	4/2/09	137	AC Assessment accountability	<b>We should know what our students know</b> and don't know on each and every important standard before they even take the test. We shouldn't be waiting for someone else to tell us what our kids know and don't know. That really isn't even important to us. What's important is what we do with that information. It's only formative if we do something with the information.	We should know We shouldn't wait
4	4/2/09	103	Assess	"If we look at kids as starting at different starting lines, we can talk honestly about how we feel about how kids learn . . .	look at kids
5	3/11/09	162	beliefs	But you have to really believe. I've heard so many people come in and say, "Do you believe that all kids can learn?" and there's nobody in a room full of educators who says, "Oh, no. I don't believe that!" but when it comes down to it, when you really look at that, do you? But then if you take it a step further and say "Do you believe all kids can learn, but some need more time, pretty much everyone is going to say, yes. So if you really believe that's true, you teach it a different way. But we don't do that.	

6	3/11/09	171	beliefs	Not all kids come with the same background knowledge. Some are really starting back here. Some are starting over here. But at the same time, traditionall we believe that they're supposed to learn it by the same date. But if we taught them differently and gave them different time, depending on what they needed, then we could even out that end time.	
7	6/2/090	#115	Context	I have a very stable staff here. Yeah, I have one level I teacher. <b>Most of my staff has been here for over 15 years or more,</b> over 30 . . . and everyone is related to somebody politically (Laughter).	
8	4/2/09	59	cul culture and poverty	"there are difinite levels of poverty and there are different cultures that go with them. . ."	
9	4/2/09	39	cul culture and poverty	"Mexican families who do very well in school - clean but no beds . . ."	
10	4/2/09	39d	cul culture and poverty	very poor Caucasian students were our biggest challenge"	
11	4/2/09	41d	Cul. Culture PLCs	PLCs need to meet once a week. As you <i>develop that culture</i> , you move from saying we do our PLC on Wed to just saying we are a PLC.	develop a culture
12	4/2/09	33	cul. degrees of poverty	"I think it's a drug culture. Your hardest students to reach are the ones where there's drug abuse in the home. It's the disconnect . . ."	
13	4/2/09	#67	Cul. Culture PLCs	Change requires a shift in culture at a school, and fundamental to a change of culture is you have to create a sense of urgency.	create sense
14	4/2/09	107L, M	Cul. school politics	The constructs of the politics here are such that I can't do what I need to do, especially with no baacking.	I can't do
15	4/2/09	93V	Curric.	"But for some teachers, doing the curriculum (by the book) would be a huge step in the right direction"	

16	6/2/09	251	D Data ACC account.	MAP accountability is usually helpful, but then there are sometimes anomalies, where you know somebody isn't doing what they are supposed to be doing and they have a high score, and what are you going to tell them?	
17	4/2/09	71i & 73b	data	How much data we have that we don't use! We need teacher inservice to refine skills in using data. We need to review data regularly to decide what interventions are needed, whether to continue or modify.	review data
18	5/29/08	#106	data	If it wasn't for the 5th grade scores last year, we probably wouldn't have made AYP	
19	5/29/08	#38	district support	I think the district's perspective and the coaches' perspective is that it would be harder to get the teachers, their older teachers, to convert to the constructivist point of view of math vs. the rote, and so they concentrated more on the Investigations approach because they knew it would be the least comfortable for teachers.	
20	4/2/09"	2e	ELL	transitioning them to English while maintaining their home language because that's what best practices tell us. . .( 123R) Start off 100% in Spanish and transition (125J)	transitioning
21	6/2/09	focus int. notes p. 3	ell	Kids who exit ELL status may be very high but NMELPA exits them from ELL so they no longer help boost the ELL subgroup score.	
22	4/2/09	123M-P	ELL language of instructon	We call sheep boregas	
23	3/11/09	#15	ELL assess	I've learned that MAP is not such a good indicator for ELL students. One girl got a 2% on MAP scores, but other assessments in Spanish showed she was at 95% proficiency.	I've learned
24	3/11/09	#41	ELL lang	"If they're Spanish proficient, by gosh test them in Spanish!"	

25	3/11/09	(after box) #5	ELL, lang	maybe we need to support them in academics in Spanish first, since they have an understanding of that language already. Maybe they don't have strong Spanish skills so English is the right thing to do. . .	support them
26	3/11/09	after box #5	ELL/ESL	I was disappointed, I mean we've had a lot of training at our schools - a lot of information on ESL techniques, and things like that, and I have to say that I didn't hear a thing out there that was that new or wonderful, and I felt like they weren't explicit enough. IT was nothing new - just basic things like graphic organizers, draw pictures to go with the vocabulary. . .	
27	4/2/09	126d-F	engagement	Elena checked off that 100% of students were actively participating because "they were raising their hands and responding. . ."	
28	4/2/09	85d	EX Fidelity/	3 days a week she's doing the Math Investigations.	

**Appendix E****Division Problem  $39 \div 5$**



Many people think the classroom is the best context for thinking about teaching and learning.

Below is one classroom scenario with three of the teacher's statements underlined.

Please read the scenario all the way through. Then, reread each underlined statement and think about each statement in the context of the entire scenario.

There are no right or wrong answers here — we are interested in learning your thoughts about what the teacher and the students are doing. Please explain your thinking as thoroughly as possible, so that we can understand your views.

### **SCENARIO**

Ms. M, a fourth grade teacher, called on Joe, one of the 24 students in class. “Joe, what is problem 9?”

“Five divided by thirty-nine,” Joe replied.

Ms. M. paused. “The problem in the book is  $39 \div 5$ , but let's think about  $5 \div 39$  for a minute. What would the answer to the problem  $5 \div 39$  look like?”

All hands went up. Ms. M. called on Keesha. “Seven remainder four,” Keesha replied confidently.

“If the problem is five divided by thirty-nine, is seven remainder four the answer?” Ms. M. asked the class. The students all said that it was. Ms. M. waited for a moment.

T.C. spoke. “The number will be like – I say zero. You can't divide five with a thirty-nine 'cause it's a higher number. You can't divide a number that's lower by one that's higher.”

Ms. M. looked at the other students and asked, “Is it true that you can't divide a small number by a large number?”

“Yes, that's true,” answered Al. “5 can't divide by 39. If you had 39 kids and 5 dollars, you can't do that in a fair way. You will give 1 dollar to 5 persons and the other people will be mad.”

Dan agreed. “He's right, because the answer will be something about zero 'cause there is no answer for a problem like that.”

“You cannot do 5 divided by 39,” Jackie added, “because on a calculator it won't work out. It will come out to be a number in the minus. It will be.....” Jackie's voice dropped, and she stopped.

“Is there another situation you can think of?” asked Ms. M.

“Well, 5 people and 39 desks,” offered Dan.

Cynthia spoke up. “What T.C. said is true. If there were 39 principals and I had 5 pieces of candy to give them, then only 5 principals could have a piece. The other 34 would be mad at me and I would lose my job.”

“What about a different problem,” asked Ms. M., “what about 39 principals and 5 pizzas? Or 1 pizza and 4 kids?”

Please comment on each statement taking into account the context of the entire scenario.

**What was the teacher doing? Was it good teaching or not? Why?**

Underlined statement #1

Underlined statement #2

Underlined statement #3

**What were the mathematical ideas involved in this classroom scenario?**

**What can students learn in this class?**

**Appendix F**

**Snail Riddle**

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