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ABSTRACT

Contemporary reforms lobby for deep changes in mathematics teaching and learning, yet classroom practice continues, in many places, to be as conventional as ever. This study examines how one mid-sized urban school district marshaled resources for change in mathematics instruction. The study involved a 3-year observation of a small group of teachers, an analysis of the allocation of resources, and interviews with principals and central office staff to explore the impact of administrator attitudes and agendas on change in mathematics instruction. Teacher observation found that, though all eleven focal teachers were using new "reform-oriented" mathematics textbooks and most added some manipulatives and problem solving to their teaching, only one teacher seemed deeply involved in the ideas of the mathematics reforms. Resources available for reading and language arts were found to be dramatically more extensive than for mathematics. Interviews with six principals found that each had a personal agenda where mathematics reform fell deeply into the backdrop of daily concerns. Interviews with central office staff suggested that their familiarity with reforms was modest and often represented in slogans. Central office staff justified resource allocation to literacy efforts because they believed reading was prior to everything else. The paper closes by arguing that relatively ignorant of mathematics reforms, administrators are less inclined to allocate the significant resources necessary to effect real change. (Contains 24 references.) (JB)

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Marshaling Resources for Reform: District Administrators and the Case of Mathematics

Jeremy N. Price, Deborah L. Ball, and Susan Luks

NCRTL

National Center for Research on Teacher Learning

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MARSHALING RESOURCES FOR REFORM: DISTRICT ADMINISTRATORS AND THE CASE OF MATHEMATICS

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Abstract

Contemporary reforms lobby for deep changes in mathematics teaching and learning and yet classroom practice continues, in many places, to be as conventional as ever. This publication examines how one midsized urban district marshaled resources for change in mathematics instruction. In contrast with literacy where staff, experience, and concern were extensive, mathematics lacked parallel resources for change. Considering the magnitude of the changes envisioned in teaching, learning, and knowledge, as well as key district players' ideas, understandings, and agendas, we argue that there is a paradoxical inversion of resources needed to tilt the system in the direction of mathematics reform.

MARSHALING RESOURCES FOR REFORM: DISTRICT ADMINISTRATORS AND THE CASE OF MATHEMATICS

Jeremy N. Price, Deborah L. Ball, and Susan Luks

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Over the past fifteen years, a new wave of reform in mathematics education has splashed onto the national landscape. Beginning with the National Council of Teachers of Mathematics' *Agenda for Action*, published in 1980, a host of prominent national documents has appeared, promoting an ambitious vision of challenging mathematics instruction for all students. (California State Department of Education, 1985, 1992; National Council of Teachers of Mathematics, 1989, 1991; National Research Council 1989). Not since the demise of the "new math" of the late 1960s has school mathematics been the object of so much attention. Based on the documents and their visibility, mathematics appears to be ahead of the other curricular areas in terms of direction, clarity, and vision. Consequently, on the national scene, educators and policymakers alike look to emulate the successes of the mathematics education community in order to animate reform agendas in other subject areas. Yet a closer, more local look inside classrooms reveals that the headlines of success may be premature. Many students continue to experience a traditional mathematics curriculum of memorization and procedures, classrooms where teachers talk and students listen and practice. What is happening to the grand mathematics reform visions? Why do they not seem to be permeating modal classroom practice?

In this publication, we offer one perspective on this puzzle. Given an interpretation of the mathematics reform movement as pressing a set of deep changes in mathematics teaching and learning, we argue that it would take substantial resources for these ideas to take hold in schools. The vision of mathematics instruction represents a dramatic shift in what is taught, how it is offered to students, and what students would do and learn. Whereas current practice is dominated by drill and practice of basic skills and manipulation

of symbols, punctuated by word problems that "apply" skills in fictional contexts, the reforms promote a broadening of curriculum to include topics such as probability, geometry, number theory. Reasoning and problem solving are held as central. Reformers envision teachers telling less and children engaging in complex thinking more, more emphasis on the meaning of mathematical ideas, less on speed and memorized recall. But mathematics as a collection of rules, mathematics instruction as showing students to follow those rules, mathematics learning as rapid and accurate computational skill are deeply rooted in schools. This is the mathematics experience of teachers and administrators who face making the changes promoted by the reforms. It is the experience of a public which expects schools to produce mathematical competence, defined as speed and calculational skill.

Exchanging traditional assumptions and expectations for new ones would require substantial resources—ideas, images, materials, time, and opportunities to learn about mathematics, students, and pedagogy. In a system not rich with such resources, extraordinary effort would be needed to marshal them. Mathematics does not typically garner a giant share of educational investment; making change of the sort envisioned by the reforms would require an enormous shift in the resources allocated to mathematics. Such a shift seems unlikely to be accomplished solely by a commitment of more money for mathematics reform. The reforms would require administrators and teachers to revisit and revise in fundamental ways their experiences of mathematics, students and pedagogy, to reconsider what knowing and learning mathematics entail. A big question is whether and how the mathematics reforms can compete for such resources among the multiple agendas pressing on schools? To what extent can mathematics muster unusual force among other, more traditionally dominant missions, such as literacy? What are some of the factors that support or impede the marshalling of needed resources for mathematics reform?

Resources for Mathematics Reform: A Case of One District

In our study of a small group of teachers in a midsized urban district over the past three years, we have been keeping our eye on the marshalling of resources for mathematics instruction and teacher change. While all our teachers were using a new "reform-oriented" mathematics textbook, and most were inclined to add some manipulatives and "problem solving" to their mathematics teaching, only one of our eleven focal teachers seemed to have become deeply involved in the ideas of the mathematics reforms. Our interest was piqued when we noticed that the resources available in reading and language arts seemed dramatically more extensive than in mathematics. Few resources existed to support real change in mathematics. While we acknowledge that the resources to support literacy were also in many cases inadequate, we argue in this paper that the contrast in resources between mathematics and literacy was striking, especially when examined from a perspective of what deep change would require.

The story of the Mapleton district's mathematics program reveals a critical gap between national visions, state curriculum guidelines, and local agendas. Examining this gap helps to explain why the mathematics reforms may actually have little chance to germinate. Our analysis is premised on the idea that principals and other district leaders are crucial in the allocation of resources to particular efforts.

This paper appraises the resources afforded by the district to the mathematics reforms and offers an argument for why the resource patterns look as they do. Although some might see local districts as conduits of state and national policies and agendas—primarily as implementors (Berman & Pauly, 1975; Crandall, 1982; Gross et al., 1971; Smith & Keith, 1971)—we base our work on the assumption that districts are active policymaking contexts. We assume that district staff members shape priorities, agendas, and directions, and that they do so in light of the specific ideas and commitments that they bring to any particular set of initiatives (cf. Spillane, 1993). Beyond these kinds of individual readings of and responses to the reforms, however, we also conjecture that the substance of the policy may affect locals' reaction and response and that there may be systematic subject matter or other area differences. In this

case, we investigate the marshalling of resources for mathematics and examine factors that may shape the comparatively thin allocation of resources for mathematics as compared to reading.

We begin by introducing the district, including an orientation to the context and demographics of the district in general, as well as a brief history of emphases and change in mathematics instruction and curriculum. We also provide an overview of the current agenda in mathematics. Then, for a closer view of practice, we pay a brief visit to the classroom of one of our teachers. This snapshot illustrates the relatively modest influence of the reforms in the classrooms we have been studying. Moving back outside the classroom, we examine district resources available to marshal and support an agenda for change in mathematics teaching. Given what Mapleton teachers and administrators bring to the challenge of reforming mathematics education, we argue that these resources are inadequate in crucial ways and, further, that these inadequacies stand in paradoxical contrast with comparable resources available for the reform agenda in literacy. We propose that this paradox of resources may be an important factor in the weak shape of change in mathematics.

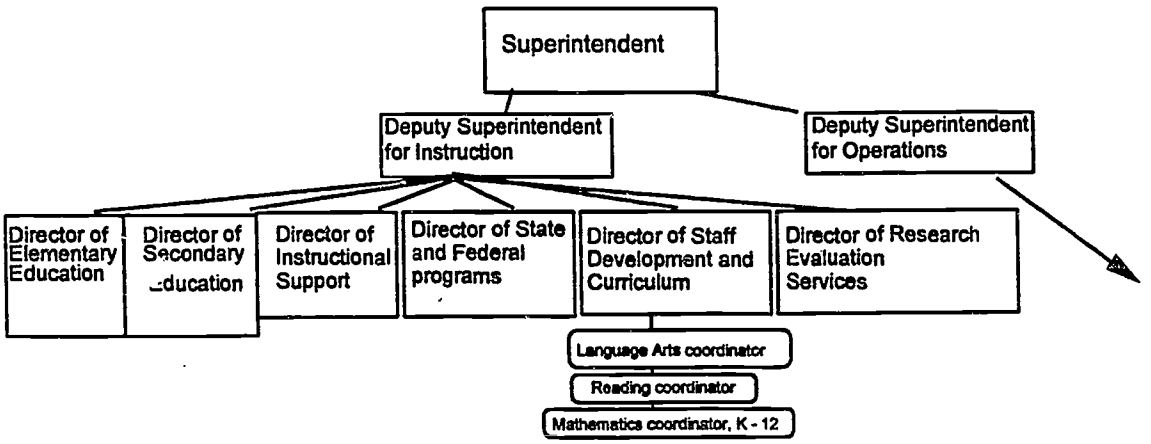
Mapleton: A Midsized Urban District

Mapleton is situated in a metropolitan area of almost a quarter of a million people. Settled in the mid-nineteenth century, the city has a main street downtown district encircled by sprawling residential neighborhoods, business strips, and shopping centers. Together, heavy manufacturing and public sector employment form the principal economic base of this Midwestern city. Although unemployment rocketed in the 1980s, presently, it stands at around 6 percent. About one in five of the city's residents is African-American; approximately 5 percent are Latino. In the early 1970s, Mapleton introduced bussing in response to court-ordered desegregation; current school boundaries are in many cases the same as those drawn then, producing puzzling results not always congruent with the aims of those who mandated bussing.

With over 20,000 students, Mapleton is one of the state's 10 largest school districts. Approximately a third of the students are African-American, over a tenth are Latino, and about half are white. A small percentage of the students speak English as a second language; their primary languages include Hmong, Spanish, and Vietnamese. While the district is primarily middle class, as many as one third of the families live in poverty.

Our work has been focused in three of the elementary schools: Burnside, McKinley, and Remington. These buildings are all among the poorer, more ethnically diverse of the district. Burnside is the only school which has no bussing. Located in an older part of the city, the school's population is about half white, one third African-American, and one sixth Latino. Almost half of the children come from families on AFDC. McKinley, located in an upper-middle class neighborhood, busses one-third of its students from a poor area about a mile away. Remington's population, almost two-thirds African-American, is highly transient. Over 70 percent of the children qualify for free lunch. Each of these three schools enrolls about 300 students. In all three buildings, there has been a turnover in administration over the last four years. We have been involved, therefore, with six building principals over the course of our study. None of these buildings has an assistant principal.

The district administration is headed by a superintendent and two deputy superintendents, one in charge of instruction and the other in charge of operations (e.g., transportation, food services, business office). A cadre of "directors" under the deputy superintendent for instruction share the central responsibilities of the district's instructional program. Figure 1 illustrates the nominal distribution of responsibilities among these directors. Although the titles suggest a unique division of responsibilities among departments, in fact, many key functions are under the purview of more than one director. For example, staff development is a matter of concern for four different departments: elementary and secondary education, instructional support, and staff development and curriculum. Leadership in specific curricular areas is provided by subject area "coordinators" who currently report to the director of staff development and curriculum (although this has changed three times over the course of our study). These coordinators work with steering groups of teachers to make curricular decisions, such as text adoption. The scope of their responsibility is



enormous: The mathematics coordinator, for example, is responsible for providing leadership and support for curriculum and staff development for the K-12 program, for over 400 teachers.

Mapleton's Agenda for Mathematics Instruction

Just before we began our study, the Mapleton school district had finished revamping its mathematics curriculum statements—the written document that specifies the district goals and objectives. While this revision process was part of the regular curriculum "updating," it occurred at a time of considerable ferment in mathematics education. Just two years earlier, the National Council of Teachers of Mathematics had published the *Curriculum and Evaluation Standards*, and the year before the state had revised and reissued its *Goals and Objectives for Mathematics* and had redesigned the state assessment to test students on problem solving and mathematical concepts. The revision of the Mapleton's mathematics goals was led by the retiring mathematics coordinator, a man who had guided the district's mathematics curriculum for over 25 years, but who was not active in the current mathematics reform movement.

Modestly revised, the new district guidelines did not attract major attention nor generate noticeable controversy. The new guidelines drew closely from the new state *Goals and Objectives for Mathematics*, even using some of the same examples and illustrations. Copies of the curriculum statements were distributed to the buildings. Without fanfare, they found their way into teachers' looseleaf binders of district curriculum guides.

Although more than one of the central office administrators told us how these objectives functioned to guide teachers' decisions and plans on a day-to-day basis, we encountered a different story when we were in schools. One day, when we were meeting with one of the building principals, we glimpsed the archaeology of these cycles of curriculum updating. Ms. Young, at Remington Elementary, had requested that her teachers turn in their binders to her. As she leafed through different notebooks, she showed us packets of curriculum objectives from other subject areas and other years still tightly shrink-wrapped in plastic, as well as layers of previous editions now supposedly outdated and replaced. One binder contained the last three sets of curriculum statements, each one filed after the other. And in talking with our teachers, we learned that not one used the district curriculum statements as a close guide for their practice.

But although the district curriculum guide did not seem to be a powerful signal for mathematics reform in Mapleton, the next two events—hiring a mathematics coordinator with both energy and vision and adopting a new "reform-oriented" textbook—sounded a somewhat louder call. The year after the curriculum statements were completed, Mapleton's veteran mathematics specialist retired, and the district appointed a dynamic new mathematics coordinator named Lydia Jackson. Active in the state Council of Teachers of Mathematics organization, Jackson had also worked closely with several prominent university mathematics educators. Her appraisal of the revised district curriculum statements was cynical:

> Granted, there's some improvement in these statements, but they're not vastly significantly different than the statements that they had the previous year. They really think that they're making headway and that they are doing things the way in which it is envisioned by the *Standards*. They really truly believe this.... Actually they think they are doing things that are in line with the [state assessment.] They could care less about the *Standards*.

She turned her energies to making more substantial changes in line with the mathematics reform movement. Her efforts, while not at odds with the state *Goals and Objectives*, were oriented around the national reforms—in particular, the NCTM *Standards*. Under her leadership, the district steering group sponsored a year of textbook piloting (1991-92). Teachers from every elementary building tried out different text series in their classrooms, seeking the one that best supported the district's mathematics agenda—as they interpreted it. Jackson worked actively to bring key elements of the mathematics reforms to the fore: more emphasis on problem solving, use of concrete materials and classroom discussions, less emphasis on skill practice, computation, and algorithms. Still, her colleagues interpreted these ideas in light of their own past experience and understandings, values and beliefs. Given the limited opportunities Jackson had to help them explore the reform ideas, and to learn things they might need in order to delve into them, teachers' interpretations of the reforms tended to be more superficial than she wanted—expressed in terms of "hands-on," "manipulatives," and "active learning."

Commenting on the district's awareness of the reforms, Jackson expressed frustration:

> It's a nightmare because people are not informed about the reform movement. They do not know what ... the *Curriculum and Evaluation Standards* are all about. They haven't a clue ... [but] our steering committee meetings are tied up this year in dealing with this pilot.... The first two of them [were] strictly working off some of the details as to how we're going to get the evaluation forms out and what's the voting procedure and rights going to be about? So we spent a lot of time on these kinds of issues instead of the issues about changing the way in which we teach mathematics. Changing our view and perceptions of what does it mean to do and teach mathematics. I had ideally thought about using the steering committee time to show and demonstrate how this also makes sense in your classroom. But there's no time to do it. There's always another agenda.

Still, Jackson distributed copies of the NCTM *Standards* to all the buildings, and made copies of the K-4 section for all the pilot teachers. Although the former mathematics specialist had set the wheels in motion for this piloting, and had already chosen three texts to be piloted, Jackson added a fourth text series to the menu of alternatives. She held meetings after school for teachers who were participating in the pilot; the *Standards* figured prominently in the focus of these sessions. In some measure, Jackson's efforts paid off: Near the end of the year, participating pilot teachers voted to select the series she herself preferred—though not wholeheartedly: Harcourt Brace Jovanovich *Mathematics Plus* (1992 edition)—as the district's new math series.

Remillard's (in preparation) examination of this particular series suggests that it includes more attention to problem solving, places more emphasis on traditionally-marginalized topics (such as probability and data), and uses manipulatives quite heavily throughout. She claims that exploration and investigation of mathematical ideas are stressed, as opposed to the traditional explanation and practice that filled the pages of the former text. Filled with ideas, suggestions, and guidance for a more conceptually-oriented curriculum, this text series is the primary tool in which the district invested for "updating" the mathematics program. Jackson had mixed feelings about this reliance on textbooks in teaching mathematics. But, she acknowledged, "the number of teachers who I know do not have the mathematical background, um, that they need something that has good information in it." A big question that remained was what teachers "without mathematical background" could make of "good information." What kind of resource could a new text series be?

By 1992, then, Mapleton had completed the formal revision of its mathematics curriculum. The district's mathematics agenda, consistent with—if not directly shaped by—the state's *Goals and Objectives for Mathematics*, was officially launched in the direction of a more conceptual and problem-solving oriented curriculum. With a dynamic and knowledgeable

mathematics coordinator at the helm, Mapleton seemed to have marshalled strong resources in support of the mathematics program. In the cycle of curriculum revisions, the district moved on to the next curriculum area—computer education.

To get a glimpse of what many Mapleton teachers did in the wake of this recent wave of curricular redefinition and revision, we turn next to the classroom of Dave Burch, a fifth grade teacher at Burnside Elementary. In spite of Jackson's visions, this lesson is quite typical of what we saw in most classrooms—instruction that continued to be both closely tied to the textbook and teacher-centered.

A Visit to Mr. Burch's Fifth Grade

1992-1993 was Dave Burch's first year at Burnside as well as his first year teaching fifth grade. When he compared Burnside with his previous school where he taught third grade, Burch saw it as an inner-city school whose students were academically behind and had many social problems. The mix of students in his class included eleven white, nine African-American, six Latino, one Vietnamese, and one Iranian. Of these students there were three whom Burch labeled "special ed," one labeled "learning disabled, "and two who had "trouble with English" and participated in the school's bilingual program for most of the day. Because Mr. Burch believed that mathematics was not language-based like other subject areas, it was in fact the only subject that he continued to teach to all his students together.

Burch's classroom was bright and spacious. The bulletin boards, as well as the empty wall spaces throughout the room, contained handwritten posters with slogans conveying expectations about behavior: "Respect Diversity," "What Active Listening Looks Like . . . ," "Rules of the Classroom . . . ," and lists of student jobs. Underneath the windows were shelves of trade books, sets of dictionaries, and individual cubbies where students turned in their work. In the front corner of the room stood an unused Apple II computer. The front and back walls of the classroom each had a large chalkboard and a smaller bulletin board. Mr. Burch often conducted lessons from his desk which sat at the front of the room. Students' desks were clustered in groups of three, four, and five, and were not all facing the front of the room. Mr. Burch's instruction often required students to turn their chairs to face him.

Burch was directly involved in the mathematics textbook adoption process. In his third grade classroom, he piloted two of the candidate text series. He recounted that 80 percent of the piloting teachers—himself included—had favored the book chosen over the other three series that were piloted. Nonetheless, he had criticisms of the new series. He believed that the book was difficult for students to read because there was so much text before the actual exercises. He also believed that there were not enough practice exercises for each concept in the text, and that students must practice in order to learn. He compensated for this by supplementing the new text with practice from the old.

Burch's views of the textbook were pertinent because the text was the core of his mathematics teaching. Leading students through book pages one problem at a time, he rarely deviated from what was written in the text. The following segment from a lesson on measurement was typical of Burch's math teaching as well as that of most of the other teachers we observed, with the textbook providing both setting and script. Burch used the book's examples, asked its questions, and assigned its problems. The students' role was to respond to the teacher's directions and questions.

On this particular day, Burch began the lesson by writing the following on the board:

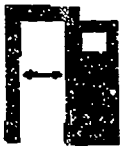
p. 350

millimeter
centimeter
decimeter
meter
kilometer

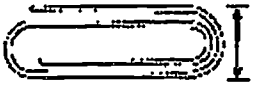
Units of Length

Kimiko and Nat must choose a unit to measure their model ship.

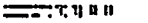
Units of Length
1,000 millimeters (mm) = 1 meter (m)
100 centimeters (cm) = 1 meter
10 decimeters (dm) = 1 meter
1 kilometer (km) = 1,000 meters



1 meter is about the width of a doorway.



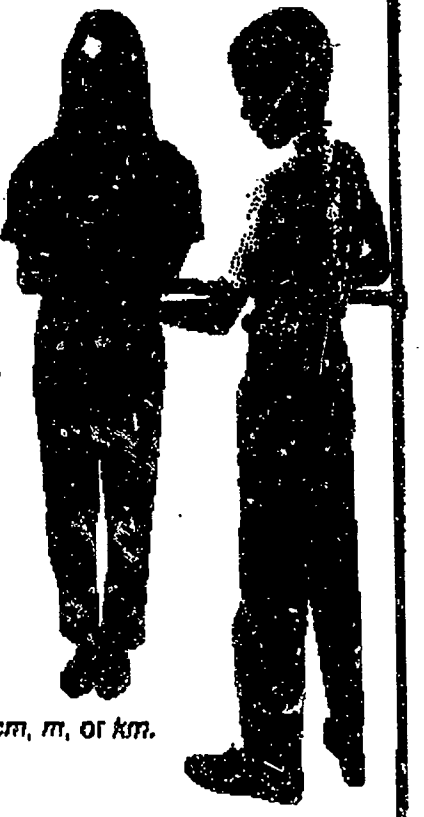
1 centimeter is about the width of a large paper clip.



1 millimeter is about the thickness of a dime.

The model ship is smaller than a meter. Centimeters can be used to measure objects smaller than a meter.

So, it is reasonable to measure the model ship in centimeters.



Talk About It

- Which units are smaller than a meter? larger than a meter?
- Which unit would you use to measure the height of your desk? Explain why you think your choice is reasonable.
- What objects in your classroom would you measure in meters? Explain why you think your choices are reasonable.

Check for Understanding

Choose the most reasonable unit of measure. Write *mm*, *cm*, *m*, or *km*.

1. thickness of paper
2. distance to the next town

Write **a**, **b**, or **c** to tell which measurement is the most reasonable.

3. 

a. 6 dm b. 6 cm c. 60 m

Practice

Choose the most reasonable unit of measure. Write *mm*, *cm*, *m*, or *km*.

5. length of a spelling book
6. distance from the earth to the moon
7. height of a chalkboard
8. distance around a baseball field
9. thickness of a dime
10. length of a piece of chalk
11. length of a bus
12. distance from your home to school

Write **a**, **b**, or **c** to tell which measurement is the most reasonable.

13.  width of a window — a. 10 cm — b. 10 dm — c. 10 km

14.  diameter of a ring — a. 15 mm — b. 15 cm — c. 15 km

15.  length of a crayon — a. 8 mm — b. 8 cm — c. 8 dm

16.  length of a car — a. 4 dm — b. 4 m — c. 4 km

Mixed Applications

17. **Write a Question** Chin measured his plant's growth on each of seven days. By the seventh day his plant had grown 21 mm.

18. Franklin and Candy cut 12 pieces of wire that were each 20.5 cm long. How many centimeters of wire did they cut?

19. Mildred kept track of rainfall during four weeks for her science project. She measured 1.4 cm the first week, 2.1 cm the second week, 1.8 cm the third week, and 2.9 cm the fourth week. How many centimeters of rain fell during four weeks?

20. Greta and Mario measured the length of the chalkboard. Greta said it measured 3 dm long, and Mario said it measured 3 m long. Whose measurement was more reasonable?

More Practice, Lesson 11.1, page H74

WRAP UP...

He then directed students to get out their "new math books" and, after waiting for a lot of shuffle to end, began the lesson. Engaging in little interaction with students, Burch marched through the textbook page, explaining the various units of measurement listed on the top right hand page of his textbook page.

> Page 350. Look at that chart. Look at that chart on the right hand corner where it says units of length in the blue. It tells you how many millimeters make a meter, how many centimeters equal one meter, and how many decimeters make a meter and how many meters are in a kilometer. So this is how they go as far as size. Is everyone with us yet? 350? This is from the smallest to the largest. Millimeters, then centimeters, decimeters, then meters. Kilometer or *kilo*meters as some people call it—doesn't matter to me, either way—okay—so, it takes 1000 millimeters to equal one meter. And a meter, if you look, is about the width of that doorway. So, this is the meter. It's 100 centimeters in a meter, 10 decimeters in a meter, and it takes a 1000 meters to make a kilometer.

Using the example from the textbook, Burch said, "so a paper clip is about one centimeter in width." He then moved to the classroom door and announced, pointing at the doorframe, "it'll take 100 of those—if you lay them side by side to go from here to there. That gives you some idea of how long things are." Continuing, he paraphrased the caption from the next illustration in the book: "A thickness of a dime is one millimeter." He held a dime up in the air and informed students it would take 1000 of them to go from one side of the door to the other.

As Burch moved through the sections "Talk About It," "Check for Understanding" and onto "Practice," the class appeared to be attentive. He and his students played their familiar roles well: The teacher asked questions, the students answered, the teacher affirmed or corrected. There was little side conversation among students and no interruption from students asking questions.

Burch seemed to control much of the discourse in the classroom. For example, he would call on students and asked them to read from the textbook. Frequently, he repeated what they read, adding emphasis. On another occasion, when he got to the "Talk About It" section of the textbook, he changed his role to that of questioner, reflecting the switch in the book's format at this point. For instance, he called on Barry who read the question, "Which units are smaller than a meter?" Burch then restated the question and asked Amy for an example. "Centimeter," she offered. And so Burch moved on.

The class continued moving swiftly through the questions in the order they appeared on the pages in the book. At the top of page 351, Burch asked firmly,

> Number five. Length of a spelling book. Your spelling book. Would you use millimeter, centimeter kilometer, or—? You need to look at page 350 to give you a clue. Liesha, what would you pick? Think about it before you answer, don't just babble.

He paused.

> When you have an answer—anybody here have an answer yet? Raise your hand when you think you know the answer. How 'bout anybody at the back table yet? Anybody at that back table with an answer to number five? Now we're waiting on Janeya, Liesha.

When most hands were raised, he asked Liesha for the answer. Hearing the right response, he said "correct" and then moved on to number six. "The distance from the earth to the moon?" he asked, looking out at the children.

In "Mixed Applications," the last section of the lesson, a student was called on to read number 18: "Franklin and Candy cut twelve pieces of wire that were each twenty point five centimeters long. How many centimeters of wire did they cut?"

Burch:	Okay, what's the numbers we have in this problem? Derek?
Derek:	20 and 5?
Burch:	*20 point 5* is <u>one number</u>. What's the other number? Any other number?
Derek:	12
Burch:	What do we do with those? Raise your hand and tell me.

A student yelled out, "*Times*!!" Burch said, "Twenty point five times twelve. How do you come up with an answer?" Without waiting for a response, he swiftly did the multiplication on the board. Turning back to the class, he asked where the decimal point goes. "After the 6," someone offered. Without comment, Burch put it on the board.

Through demonstrating for the students the procedures and operations to solve the problems in the textbook, he finished working through the remaining problems. The students observed, and were to learn what to do from following his steps. To ensure that students knew what they were responsible for, Mr. Burch concluded the lesson by instructing them to memorize the chart on page 350. He announced that they would be asked to know these metric equivalencies on a class test. And, he added, "These are things you're gonna have to know on the SAT test." Raising scores on this test was one of the main aims of the district, according to Burch. And he was committed to do his part to achieve that goal with his students, a commitment that leads him to make sure students are practicing and memorizing.

The textbook was indisputably central in Mr. Burch's teaching. He used the examples, questions, and exercises the textbook's authors had included in the section. Therefore, Mr. Burch's practice would at times reflect elements of the reforms—to the extent that the new text series itself embodied them. But the textbook was by no means the singular determinant of what Burch did in his classroom. In following the text, his teaching was also significantly shaped by conventional habits, orientations, and beliefs. His own knowledge of mathematics affected the way in which he read and used the book. In this lesson, Burch had the reins and controlled the talk; what was talked about centered on small facts and right answers to be memorized. Neither teacher nor students discussed the ideas or raised questions of their own; instead, they followed the book's script together. And students' turns were small and constrained.

Burch's views of learning, his notions about mathematics and measurement, his perceptions of his students and what they need—all these interacted in his practice. These views were important influences on what he did as a teacher, and they affected how he made use of the textbook. They directly affected what kind of a resource the textbook was for him. A teacher with deeper, more connected, understanding of measurement might possibly be able to adapt and use the text's ideas in a more productive way. Neither were his ideas idiosyncratic; rather, these beliefs are conventional and deeply rooted in our society. That he may not have deep understandings of mathematics is also not unique, but a predictable result of his own experiences in math classes (cf. Ball 1990a, 1990b; Simon, 1993).

Despite the district's efforts to bring mathematics instruction in step with current reforms, Dave Burch was more concerned with other issues. Asked about the NCTM *Standards*, Burch recalled hearing that it was a new test. Although he was one of the 80 Mapleton teachers who participated in piloting mathematics text options, he is unaware of the thrust of the reforms and unfamiliar with the reform rhetoric. He does not even clearly remember Lydia Jackson, the mathematics coordinator. Changing mathematics instruction, curriculum, and learning were simply not central to Mr. Burch's agenda. Mathematics reform was not on his mind.

Resources for Reform—Promise and Limits

Our observations of other Mapleton teachers' classrooms suggests that Mr. Burch's classroom—and Mr. Burch himself—are quite typical. With the textbook providing questions and examples, practice and review, teachers and students move together through the curriculum materials. The mathematics they do is for the most part a mathematics of procedures and exercises, the discourse decidedly teacher-centered, and the environment right-answer-oriented. No big surprise here. This is what they experienced in school themselves; most have never seen mathematics teaching built on the commitments of the *Standards*. Sitting through years of mathematics classes where memorization was key, and understanding beside the point, they have not had opportunities to explore mathematical ideas in any depth. While they may remember particular algorithms, their own understandings of core ideas are often thin and unconnected.

The glossy new mathematics text series, selected as a vehicle for Mapleton's curriculum guidelines, and updated to incorporate the *Standards'* emphases, was indisputably an important resource for teachers like Dave Burch. Underlying ideas are stressed, both for the teachers and for the

students. And Burch, consistent with habit, followed it faithfully. But the textbook also had limits. Pages 350 and 351, from Burch's lesson, provide a glimpse of the modest ways in which publishers have tended to interpret and respond to the reforms. While students were asked to make estimates of distance and length, they did not actually engage in measuring anything. Measurement remained inert, pictured on the pages of the book, not as a mathematical topic with important applications in the real world, and which involves judgment, estimation, and physical skill. It is instead represented as an abstract matter of equivalencies and facts. In her analysis of this text series, Remillard (in preparation) notes:

> The text includes many characteristics that fit with the ideas of the reforms, but little of the "old stuff" has been let go, allowing teachers to choose the items that best fit their orientation toward teaching. Long-held goals and perceptions of mathematics, such as computational mastery and traditional content organization, are still prevalent, thus, it appears very familiar. The publishers have managed to fold in a range of possible alternatives to traditional practices without upsetting the status quo.

And, with hundreds of pages intertwining old and new, the text offers little guidance about emphasis. Lydia Jackson, the district mathematics coordinator, was sharply aware of the limits of the new textbook to effect major change. She could have been talking about Dave Burch when she remarked:

> There are more chapters instead of fewer, the teachers are still faced with this awesome task of what is it I'm going to really teach? Because they still start at the beginning and they work through till the end. I have teachers who say they skip around but there's not that many teachers who do that. So I have also the job and responsibility of helping teachers make decisions of what to leave out. That's a big responsibility.

The process of textbook revision means that this text, like most series, is in many ways quite similar to previous editions. Further, since the reform ideas include not just attention to content but also to the environment and discourse of classrooms, a textbook may not be the best lever to stimulate and support all aspects of the reforms. As a result, while the text can offer some new ideas and new approaches, it is not enough to lead Mr. Burch to change dramatically what he teaches or how he teaches it.

Shaping a mathematics curriculum responsive to the national and state-level reform agenda requires careful thought, active work, and opportunities for reflection. It also requires ongoing learning. For teachers to change their mathematics instruction in the direction of the reforms would entail more than casting off their old textbooks and unpacking their new ones (cf. Cohen & Ball, 1990). Teachers also need to understand and be committed to the new goals. They need opportunities to learn more mathematics in depth themselves, to look closely at their students' thinking about that mathematics, to explore ways to respond to students' ideas, and to talk with others who are trying to make these changes in their practice (Heaton, 1994; Simon & Schifter, 1991). They need time, ideas, and images. They need sustained opportunities to learn and support to experiment in practice.

Mr. Burch's principal could play a role in helping to get mathematics and the reform of math teaching more squarely in view. Maybe a mathematics specialist teacher could help him know about the agenda for mathematics instruction in Mapleton, as well as about the mathematics reform movement—its central aims and ideas. Perhaps someone else—a workshop leader—could also inspire him to care about it, and support him in being a learner as he considers how the ideas fit in his classroom, what he might try with his students. Mr. Burch has been to some meetings with Lydia Jackson, meetings centered on the textbook piloting and selection process. But such contact has been too thin to make a difference. Jackson, singly responsible for the entire district's mathematics curriculum—for the work of over 400 teachers, did not have substantial contact with Burch, even though he was one of the pilot teachers. In fact, later he could not even recall who she was.

For Burch, the selection of a new text seemed little more than normal district "updating." In fact, language about problem solving and other "new" aspects of the textbook series only served to reinforce a sense that this change was little more than routine curriculum revision to make the district nominally more current.

Moreover, the conversation seemed centered on content—what to teach. None of this impressed on him that his mathematics *instruction* was to undergo any substantial change.

Repeatedly Jackson told us that she alone could not accomplish this ambitious reform in Mapleton. With just one of her, and all of K-12 to worry about, her job was vast:

> And I'm in a position that I can not dictate what you will do in your elementary buildings. I can't dictate it, I can not dictate what the curriculum is going to be. If the teachers are not in agreement . . . just because I put it on paper is not going to make it solved.

Neither can a new textbook alone meet the challenge of change. As Burch's teaching shows, teachers' existing beliefs and understandings will shape their use of even well-designed and reform-oriented textbooks (Rickard, 1993; Remillard, in preparation). And no commercially-available text will divert dramatically from modal practice in any case.

Although mathematics is considered an important subject area, and the agenda for reform is ambitious, the resources allocated to supporting change in mathematics seem meager. To expect to leverage change in a complex curricular area, in a district the size of Mapleton, with one staff coordinator and a new text series seems simplistic. Indeed, as we noted earlier, in reading and language arts, the resource allocations were much more generous. At the central office level, two staff members were playing Lydia Jackson's role. In addition to a new literature-based text, multiple copies of trade books and other instructional materials had been purchased, and *every building* had a full-time reading teacher and an instructional aide. It seemed there was more district interest in reading, and consequently more attention to it. In the section that follows, we explore what may have influenced this contrast in resources.

District Administrators and the Allocation of Resources

Just as teachers' ideas and commitments shape how they interpret and approach the reforms, so, too, do administrators' concerns and understandings influence their practice. What they care about influences their priorities and attention. What they understand shapes what they do. Moreover, their decisions shape local policy explicitly through what they *do*, and implicitly, by the ways in which their decisions communicate priorities or focus. We turn next to a closer look at the administrators who provide leadership for curriculum and instruction in Mapleton. We ask: To what extent are these district leaders equipped to assist teachers in remodeling Mapleton's mathematics curriculum? To investigate this question, we examine what they bring to the agenda for mathematics reform: What do they know and believe about the mathematics reforms, such as those promoted by Mapleton, the state, or the NCTM *Standards*? Because we want to set their ideas about mathematics instruction in context, we also explore their own agenda as building or district leaders. What do they hold as central to the improvement of Mapleton schools? What is the relative place of mathematics—or literacy—in these agendas? The purpose of such comparisons is not to make claims about other areas, but merely to place the mathematics reform issues in a broader context.

In this section, we focus on what district administrators bring to issues of reforming the district's mathematics program. Our analyses probe the ideas and orientations of central office administrators and principals who make decisions, shape instructional agendas and marshal resources within the district. We turn first to consider several of the building principals, including Burch's own former and current principal.

Principals' Orientations to the Mathematics Reforms

In the main, the principals' ideas about mathematics instruction seemed thin and they did not talk much about mathematics instruction or about the reforms, even when we asked them directly. They seemed to know little about the changes in mathematics curriculum. In fact many of the principals tended to side-step our attempts to initiate conversations about mathematics instruction and to turn the conversation to another subject area, usually reading. Of the six principals whom we were studying, not one had a background in mathematics or special expertise or experience with mathematics instruction. Two of the six principals, however, were highly-regarded former reading teachers: Oletha Young, at Remington and Barb Norris at McKinley. Young said, chuckling, that she is "not as comfortable with math, but

nobody else is right now because it's new." Barb Norris of McKinley Elementary was perhaps the most forthright about her knowledge of mathematics instruction and curriculum:

> Like I said, math is not my . . . area, if I'm going to pick up an article, I'll pick it up on language arts and not math, which I should be doing more of the math. [*Laughs*]

The principals' knowledge of the reforms was represented through phrases such as "manipulatives" or "problem solving," with little elaboration. Only one of the six principals—Joan Underwood of Burnside—talked at any length about mathematics instruction, and particularly the reform of mathematics instruction and curriculum. Still, although Underwood disclosed that the district had distributed the NCTM *Standards* documents to all buildings, and that she had read the documents, she did not seem very familiar with many of the key aspects of the reform agenda. She characterized the change in mathematics as a generic change in "teaching strategies." "A lot of the process you use in mathematics resemble and are a part of what you do in reading as a process," she told us. Continuing her explanation of the connections between mathematics and reading, she argued that the reforms in both mathematics and reading represent

> the wholeness of reading and math coming together as processes again. . . . It's just a way of thinking. It's a more holistic way of thinking . . . So what stands out for me is the compatibility to reading, in the sense that you need to move to a higher level of thinking, you, it's not surface, it's not what you see is what you get, not really. It leads to discovery and investigation on behalf of the learner. It doesn't put the teacher in a position of talking and teaching the whole time, but basically allows for more interaction between the learner and the material. It allows for a multitude of solutions.

Although Underwood used similar language to describe the teaching and learning of mathematics and reading as processes, she seemed less elaborate in her ideas about the teaching of mathematics as a process. Her focus on the process of learning new ideas seemed strongly linked to her role prior to assuming the principalship at Burnside. Previously she was a staff development coordinator focusing primarily on ideas and concepts related to the learning of new ideas. While Underwood talked eloquently about processes of learning and unlearning new ideas, she was less specific about particular new ideas in mathematics instruction and curriculum.

Barb Norris's sense of the new ideas in mathematics also emphasized process. Norris characterized the change in mathematics within the district as essentially a move to "hands-on" activities in mathematics. She suggested the district was "trying to use the manipulatives." "[K]ids need to have some hands-on kinds of things because they're not learning in the way that we're teaching them now," she argued. She spoke vaguely about "hands-on" as central to the mathematics agenda:

> I don't know, I think that there have just been a lot of studies done where, you know, the styles kinds of things, but kids need to have some hands-on kinds of things because they're not learning in the way that we're teaching them now, we need to look at how we can change that.

Norris essentially characterized the changes in mathematics as the introduction of manipulatives in the classroom, but could not elaborate further. She also talked about mathematics teaching that would promote problem solving, but admitted that she was not well prepared to engage in such teaching:

> And I think looking at myself, if I were to go back to the classroom now, and I taught sixth grade for quite a while um, and I were to teach math, I would have to take like um, some workshops on how to use manipulatives, cause I'm not quite sure how I would go about doing that. . . . Um, problem solving, I think problem solving is really important and I look back on me when I was teaching math, I didn't really know about, you know teaching strategies for problem solving.

Oletha Young mirrored Norris' orientations to the mathematics reforms. For Young the new changes in mathematics were like the changes in reading, and manipulatives were central in these changes:

> It's like the new reading. We're talking about comprehension, understanding, uh, manipulatives, more time spent working with the child rather than lecture and paper-pencil and what has math been forever.

The principals whom we interviewed also did not seem to have time or opportunities to develop a better grasp of the mathematics reforms. Young argued that principals "don't have an opportunity" because the district office personnel "don't want you out of the building very much, so we don't have an opportunity for inservicing." Even when occasional workshops were available within their own buildings, other commitments prevented the principals from attending. Young, for example, was unable to participate in a special inservice session in her building because she was with "the lunch group" during the time of the workshop. And, from the principals' own accounts, only rarely was there substantive talk about mathematics instruction at their own district-level principal meetings. Underwood described how principals were provided information about the changes in mathematics:

> The district made available to us, the standards and criteria for the National Council of Teaching of Mathematics [sic]. . . . They bought both books for each building . . . and they provided a 30-minute overview of what those nature changes would be and what we can anticipate. And then along the way, they have provided for teachers and staff, a number of mathematics workshops if you care to join the steering committee. . . . The steering committee is sponsoring like hour and a half workshops every so many weeks that deal with various phases.

Underwood continued to describe the process, arguing that few principals would take advantage of the district mathematics steering committees and argued that most of the building principals in the district would more than likely learn about new ideas in mathematics from a teacher in their building.

> It's not mandated for administrators at all. As a matter of fact the administrators who are not on the steering committee probably won't attend. It'll come as another flyer. . . . It's a matter of how much do you yourself as an administrator care to know about it. It's available but it isn't mandated that you know. I believe the district's approach for administrators is basically you need to have an awareness and then anything beyond . . . will be fine for you but we're certainly not mandating it. . . . Probably of the 33 elementary principals . . . I would make a broad assumption that eight will go on to learn more about it and the others will drift along and as their staffs bring them along, they'll probably lean on one of the teachers within their building to guide and direct that rather than leading it themselves.

Principals' Own Primary Agendas

The principals whom we interviewed all did have clear professional agendas that did not focus on the mathematics reforms. While they attended to the improvement of instruction and curriculum in a general sense, mathematics curriculum and instruction was not a priority of a single building administrator. Those principals who did prioritize instructional and curricular reforms tended to prioritize language arts and reading more than any other content area in the elementary school. Other principals, notably the three principals of color, were dedicated to issues of multiculturalism, respect for diversity and building stronger links between their school and the immediate community.

Attending to their personal agendas was not an easy task. These principals all expressed concern about the amount of time they dedicated to organizational issues in their buildings, making it difficult for them to find the time to pursue an instructional agenda. In particular, Hyde and Norris characterized the time they spent on organizational leadership as time taken away from providing instructional leadership. Hyde, former principal at Remington, explained, wryly:

> When you try to be a building manager and a instructional leader, at a shop like this shop and a good third of the shops in Mapleton. You can't do both jobs, it's not possible. It's time and a half as a building manager. Forget instructional design and all that other stuff.

While Hyde and Norris argued they spent sizable portions of their daily work dealing with organizational issues, and this was echoed by the other principals, two principals did develop and promote an instructional agenda.

Norris and Young dedicated a considerable amount of time to providing support for reading instruction and curriculum in their buildings. Entering the buildings with their background and experience as reading specialists, they drew upon this expertise to provide guidance and support for teachers. "I'm really big on language arts and reading and writing, we have a writing and publishing center here," Norris shared with pride. Young, too, spent considerable time working on developing new ideas about reading. For Young and Norris, reading instruction was their passion,

and the area to which they devoted their attention when not involved in other activities. Young argued, however, her focus on reading instruction reflected a broader current found in the district:

> People have always looked at reading as being the end-all. I mean that's the most important thing, and in some ways I guess it is, if you can't read I guess you can't do some math.

While Norris and Young focused on reading instruction and curriculum in preference to mathematics, we note that they were the only two principals who focused on an agenda related to curriculum and instruction. The roles these two principals crafted were complex and linked not only to their beliefs about their role, but also their prior experiences and commitments as educators. The press for time saw each of these principals and others making decisions that prioritized some agendas over others.

Amidst the daily challenges of coordinating their respective buildings, each of the six principals has developed a personal agenda where reform of mathematics instruction and curriculum fell deeply into the backdrop of their daily life in schools. This is not necessarily because they are not concerned about mathematics, but rather because they have been provided few opportunities themselves as principals to be connected to mathematics communities and encounter new ideas and mathematics' experiences that are central to the mathematics reform activity. This leads us to look more closely at the central office leadership, and to ask: How are the reforms in mathematics in the district, as well as at the state and national levels, viewed and understood by district leaders—people responsible for influencing principals' priorities and opportunities to learn? How do the mathematics reforms figure in the agendas of the central office staff and their visions for the district's directions?

Central Office Administrators' Orientations to the Mathematics Reforms

The central office administrators whose responsibilities dealt with mathematics in some way included the assistant superintendent for instruction, the directors of elementary education, state and federal programs, instructional support, curriculum, and evaluation (see Figure 1). Although they shared key responsibilities for curriculum, staff development, and evaluation in mathematics, few of these individuals had much depth of knowledge about the mathematics reforms. All were aware that of current efforts to shift the emphasis in the direction of "manipulatives" and "problem solving," as reflected in this administrator's comment:

> Youngsters will not be spending as much time doing paper-pencil computations, you know. They will really be engaged more in problem solving, uh, use of manipulatives, and figuring out things, as opposed to sitting down, computing, and you know, getting all the addition and subtraction facts. Uh, it's really more uh, oriented towards actually uh, solving problems. . . . That's a thrust from the state, there's a thrust from the um, uh, National Council of Teachers of Math, the standards that they publish.

Like at least two of the principals, the central office administrators saw the changes as similar—and therefore generic—across language arts, science, and mathematics. The reforms, to them, centered on thinking and problem solving, on processes rather than on facts or isolated skills. The director of elementary education emphasized to us:

> There is a thread, a thread that runs through basically all of these subject matters areas. The focus is on, uh, problem solving and higher order thinking skills.

Several others commented on the new centrality of "applications"—a notion that seemed only vaguely articulated. For example, one director who was convinced that this lay at the heart of the changes that were "coming down from the state" and from the national organizations, declared:

> Application's the name of the game now. It's not the knowledge, it's the *application* of the knowledge. And the only way you're going to know whether a student can apply the knowledge is to let him *do* it.

Thinking about the reforms of subject area instruction as generic, as about process, makes it difficult to attend to some crucial aspects of the reform. For example, for a mathematics teacher to hold a good discussion about fractions, she needs to understand a great deal about fractions herself. She also needs to know what counts as evidence for, proof of, or refutation of a mathematical claim. To conduct such a discussion solely on the basis of a general sensitivity to

classroom discourse and a commitment to problem solving, for instance, would make it difficult to facilitate students' progress with the mathematical ideas. Moreover, the directors lacked specific ideas about what this shift in emphasis really meant for goals or instruction.

Most were also aware that there had been changes in the state assessment but were only vaguely familiar with the specific nature of those changes. One director, predicting that "the [state assessment] is the engine that is driving curriculum in this state," described the emphasis:

> It's testing more *process*. I mean, it's, it's, it's an extension. Maybe not an extension but it's, it's in the same spirit as the new definition of reading and the direction that the science [test] is headed. Where kids are going to have to demonstrate the skills that are necessary to solve a problem to follow a process rather then to fill in a blank or make an arbitrary choice.

One notable exception was the deputy superintendent, who herself took the tenth grade state assessment examination in mathematics. She described for us one of the items, a problem involving rotations. Clearly she had been challenged and was still not entirely sure of her answer. "Those are *not* basic skill concepts," she remarked. Commenting on the fourth grade level test, she had less detail about the nature of the items, although she emphasized that what counted was "if they can apply the applications to solve problems."

Although the directors seemed aware of a broader national agenda for mathematics reform, they cited the district's curriculum revision cycle as the impetus for updating the Mapleton agenda. One director explained:

> It's a cycle. Every five years, a subject area will come into focus. Uh, that was established some years ago through another committee that set this up as a way to really review the curriculum kinda on an ongoing cycle. And, um, math came in . . . at the cyclical time that it was established to.

The mathematics coordinator, she continued, participated on one of the state committees—"and brings in all of the new stuff that's coming down from the state"—and this provided the information link between the state and the district. Another director corroborated this relationship to the state's goal statements as well as the national agenda—"what's being done at the national level plus what's being done at state level. And out of that meld you've gotta come up with something that works for your kids."

Overall, our interviews with the central office staff suggested to us that these people's familiarity with the mathematics reforms was modest and often represented in slogans such as "hands on" or incorporated into generic ideals such as "process" or "higher order thinking" or "applications." They had had little opportunity to delve into the nature of the national recommendations for mathematics curriculum and instruction, and therefore were unable to talk in any detail about the nature of the reforms or the implications for curriculum, instruction, or staff development.

Central Office Administrators' Other Agendas

Although mathematics was not an area on which many administrators had a lot to say, they, like the building principals, had many issues that did matter deeply to them. In no case was the agenda of one of the central office administrators focused on mathematics. Their concerns ranged from raising test scores, to improving programs and outcomes for disadvantaged students, to revising assessment. And, in most cases, reading and language arts were their foremost curricular priority.

Out of her understandable frustration to manage the task of leading a large district's mathematics agenda, Jackson often commented to us that mathematics was a low priority for Mapleton. Once she related a conversation she remembered having with the then-director of curriculum:

> In reality, I don't believe mathematics is a priority because I can remember years ago before I ever got this position, that I went to the curriculum director and I asked him if he would be an advocate for mathematics in this district. I needed someone in this district who was willing to write a grant so that we could have some much better staff development programs going on. And he said he could not be an advocate for mathematics. He didn't have the time to do that.

This interpretation fit with what other administrators themselves said to us in interviews. Just as we saw in our conversations with principals, reading seemed a much higher priority than mathematics. When pressed as to why the district hires dozens of reading teachers and hires no mathematics specialists, the same director of curriculum to which Jackson had referred said that we had "touched a nerve." He went on to explain that elementary teachers are well-paid professionals and that with increasing specialists to teach the curriculum, classroom teachers are barely responsible—in his view—for anything anymore. It was only reasonable, he argued, that they teach something on their own. When we queried as to why not hire mathematics specialists instead of reading, he told us that, with the increasing emphasis on process and problem solving, "if you can't read, you won't be able to perform successfully in mathematics." This notion of reading being fundamental to everything else, and particularly to mathematics, was echoed by many of the other administrators. Another director, when asked if the district placed a higher priority on reading than on mathematics, replied, "Reading is so basic and fundamental to everything else that youngsters do and they have to know how to read in order to *do* math." To her it was obvious that reading should receive the lion's share of the attention—funding, staffing, and staff development, for the ability to read was prior to everything else, including mathematics.

Another central office administrator justified the priorities differently. She remarked that making changes in reading was much more challenging than in mathematics, because

> the content of mathematics is . . . less ambiguous. . . . It's easier to give students things that they need to apply in mathematics until the concepts get, until you get into trig problems sometimes there isn't an answer, you know. . . . But I think mathematics as a content is more exact than language. Because language brings all of the cultural dimensions and subcultures. . . . So language is a little different. We don't really know how kids read, learn to read, and we don't really know if kids learn anything, quite frankly. But we know that somehow or another it happens in the human mind because we're capable of it intrinsically the human body is capable of doing it, the human body is capable of taking in stuff. But I think it's easier for a math teacher than a language teacher.

For her, teaching and learning in reading were more complex than in mathematics, and so justified the differential allocation of resources.

The Paradox of Mathematics Reform: Low in Priority, High in Need

Administrators—in the central office or in buildings—are in positions of power to affect the marshalling of resources around particular agendas. They allocate funds for materials, professional development, and staff. They influence teachers' priorities, in the form of concern and time. Thus, what they care about and understand can have crucial consequences for the development of any particular reform agenda.

Mathematics: Low in District Priority

Our analyses suggest that, in Mapleton, both building principals and central office administrators were relatively unfamiliar with the mathematics reforms. When they described the district's agenda, they emphasized generic processes, and they seemed to have thought little about the shape these ideas might take in classrooms or what, specifically, teachers might need help with. Although they were vaguely familiar with the state and national reform agenda, their understandings were similarly thin and unfocused. They used common buzzwords like "manipulatives," "problem solving" and "application," but had little to say that went beyond identifying these as core elements of the reforms.

That administrators, both at the building level and in the central office, were unconnected to the mathematics reforms and the ideas about improving mathematics instruction, had important consequences for the district's agenda in mathematics. In a fundamental sense, because the administrators had so little involvement in the ideas and their underlying rationale, mathematics fell somewhat naturally lower in overall district priorities—certainly much lower than, for example, reading/language arts. In fact, the enormous discrepancy in staffing for reading and language arts versus mathematics was one obvious case in point. In reading/language arts, Mapleton had on staff over 30 specialist teachers, as many instructional aides, and two subject area specialists. Whereas in mathematics, Lydia Jackson was *the* mathematics staff for the entire district. This contrast was quite dramatic. In Mapleton, one person was

expected to launch and promote reform in mathematics and create professional development opportunities in mathematics for the entire district in elementary, middle and high schools. Yet in reading language arts, there were over thirty specialists in elementary schools alone who undertook such responsibilities in reading.

Essentially, Mapleton administrators' lack of familiarity with the mathematics reform agenda meant that they were less inclined to allocate resources crucial to making the kinds of changes Jackson envisioned. They were also less likely to provide more than superficial support for teachers, to explain and justify the reforms to parents, and to lobby for additional resources from the community or the school board. With no special personal interest in making ambitious mathematics reforms happen, the routine revision of the district objectives and the adoption of a new text seemed sufficient to most administrators. And having a dynamic new mathematics coordinator, who was energetically dashing around the district, only served to animate the belief that mathematics was "taken care of."

Mathematics: High in Need

The paucity of local resources for mathematics reform presents a paradox for reformers. For a district to make the changes envisioned by the NCTM *Standards* would be an unusually challenging task, requiring exceptional resources. Yet when those in positions of power lack understandings of and commitments to the reform agenda, as in Mapleton, they are unlikely, in the face of the fiscal and political pressures they face, to allocate adequate resources for mathematics.

Making change in mathematics presents unusual challenges for a number of reasons. First, the mathematics reforms are far from a blueprint for action, a plan to be implemented. A blend of vision and commitment, the reform agenda sets out instead a direction for focused development and invention. The patterns of mathematics teaching and curriculum are deeply rooted in schools (Cohen, 1989); changing from a curriculum of algorithms and calculation would take extended effort.

Second, elementary teachers are less well-prepared in mathematics than in many other areas—certainly less well-prepared than in reading. Their formal mathematics education is typically thin, and they often do not feel mathematically competent or confident. Developing the visions of reform to engage children in intellectually serious mathematical work is a task for which most teachers would need significant opportunities to learn as well as substantial support. When the Mapleton teachers worked across an entire school year to select a new text series, they were making a choice that would, in this case, shape their principal opportunity for learning. And yet, at this point, they could not fully comprehend the vision that they were being asked to use to guide their work; thus, their preferences were shaped as much by their existing understandings and commitments as by those that reformers were promoting. Ultimately, this would limit the kind of opportunity the selected text was likely to offer.

Third, working to educate and inform the public about the nature and rationale for mathematics reform is no simple matter. Community interest in mathematics instruction is not high, and perspectives on what students need to know are, for the most part, conservative, comprising basic skills and computational prowess. Lacking deep mathematical literacy themselves, most people remember being stung by the last wave of mathematics education reform—"the New Math" (Sarason, 1982)—and are not convinced that a curriculum focused on "reasoning" and "thinking" will equip students with what they need to learn. That the reform agenda is underdetermined and uncertain—in need of continued development and revision—makes the task of communicating with and convincing the public that much harder.

Comparing Mathematics with Reading: A Paradoxical Inversion of Resources and Needs

Both by interest and by default, reading is central to the elementary curriculum. Among Mapleton administrators, some brought to their work extensive background and experience with reading and language arts. They were connected to the reading reforms, had ideas about what they implied for classroom practice, and were inclined to allocate resources in support. Even when reading is not an area of expertise or special interest, it remains, perhaps by convention, a high priority. Attention and concern seems titled by default toward reading. Those who told us that reading was fundamental to everything else expressed a widely-shared belief. The expertise and assumptions that administrators bring to making decisions about reading mean that

they are likely to be concerned with providing resources for the district's language arts programs. Our colleagues' work investigating the evolution of state reading policy shows that, at the district level, different commitments and interpretations of reading and of reading reform, lead to different decisions about the nature of resource allocations. But no matter what, reading seems consistently to be centrally on the agenda.

Mathematics enjoys no such automatic attention or interest. Lower in priority than reading, mathematics instruction is often weakly supported. With less support, mathematics instruction is difficult to change. In many classrooms, the curriculum and students' experiences with it, are much the same as they were fifty years ago, despite much rhetoric and concern. That mathematics is usually less well-supported than reading is understandable when one examines closely what Mapleton administrators brought to their work: Mathematics was not a central area of interest or expertise for any of them. It was not surprising that they did not accord substantial attention or resources to mathematics. And yet, one could argue that mathematics reform is more in need of significant support than is reading.

This raises a fundamental paradox about the allocation of essential resources for reform in mathematics: If people who are in positions of power are themselves not oriented to the specific challenges of the mathematics reforms, they are less likely to make it a high priority. Further, if the defaults of schooling are more strongly set on reading and language arts, it would take extraordinary effort to reverse this natural pattern of priorities. And if extraordinary—not just basic—resources are not levied in support of efforts to make change in mathematics teaching and learning, the promise of deep reform is dim.

Paradoxically, those responsible for allocating resources are themselves more familiar with and committed to reading and language arts and, yet, without time to examine and learn about a host of ideas related to mathematics teaching and learning, and about mathematics itself, they are unlikely to shift their priorities. Could something be done to change this paradoxical inversion of resources and needs? Could fundamental patterns that prioritize reading and marginalize mathematics be altered? District leaders must somehow themselves have opportunities to learn and become committed to mathematics in ways that would incline them to commit resources more adequately, in a more appropriate relationship to need. This would not be easy, for in times of fiscal cutbacks, increasing attention to mathematics might be seen as decreasing concern for literacy. Managing ambitious reform in a time of overall reductions in resources presents a set of puzzles that complicate the already difficult problems of change.

Understanding in this way the crucial role played by districts in marshalling resources for reform illuminates the gap between the proudly heralded mathematics reforms and their disappointing failure to take root in classrooms. Taken seriously, the mathematics reforms point to fundamental revisions in views of knowledge, of learning, and of the relationship of teachers and students in classrooms. Without dramatically different local policymaking about resources available, however, the rhetoric of mathematics reform has little chance to comprise more than superficial shifts in the surface features of classrooms and a splash of new slogans. Doing so would require administrators to have opportunities to learn about—not just be updated—the substance of the mathematics reforms and about what it might take to realize these ideas in classrooms. And it would require them to make different choices about the allocation of resources to mathematics reform, both in terms of kind and extent.

Notes

[1]Mapleton is a pseudonym, as are the names of all people who appear in this paper.

[2]For example, at one of the schools where we have been working, poor African-American children are bussed from the other side of town to be with the poor African-American children in the school neighborhood, while the middle-class white children in the neighborhood attend a different nearby school.

[3]The copies of the text pages included in this section show the material from which he drew his lesson.

[4]Heaton (1994) argues that trying to teach mathematics for understanding necessarily involves teachers in a challenging process of invention and improvisation. On one hand, she argues, the mathematics reform agenda is new and underdetermined. It is a set of ideas and commitments, not a model of practice. On the other hand, she argues, this kind of teaching cannot be wholly prespecified. Teaching for understanding also means constructing practice in response to students' ideas — a process that, in its essence, must be situated in the particular and cannot simply be designed and implemented.

[5]Spillane's (1993) study of the role of districts in a state reading reform illustrates the powerful role played by individuals at the district level and the ways in which their own commitments shape their interpretation and enactment of the reform.

[6]Because our analysis of the central office administrators' understanding of and concern for the mathematics reform agenda is not centered on differentiating among these individuals, we have chosen not to refer to them by name or title. Doing so necessarily would compromise our commitment to confidentiality in ways that referring to teachers or principals does not, and it not necessary to distinguish among these people for the claims we make here with respect to the relative lack of attention accorded to mathematics among the central office administrators. The point is a more general one about them as a group, and about the district as a whole.

[7]Our claims do not address the nature or depth of these administrators' attention to reading and language arts. Instead, we claim that with greater interest in and valuing of reading, and more resource allocation of all kinds, there is greater opportunity to consider issues related to teaching and learning. By comparison, the opportunities to even begin to explore issues of curriculum and pedagogy in mathematics are slim.

[8]e.g., Ball, 1990b; Simon, 1993.

[9]For example, see Spillane (1993), Jennings, (1992), and Cohen, Grant, Jennings, & Spillane (in preparation).

[10]See Wilson (in preparation) in which she writes about policymakers as learners and about policymaking as inquiry.

References

Ball, D. L. (1990a). Breaking with experience in learning to teach mathematics: The role of a preservice methods course. *For the Learning of Mathematics, 10* (2), 10-16.

Ball, D. L. (1990b). The mathematical understandings that prospective teachers bring to teacher education. *Elementary School Journal, 90*, 449-466.

Berman, P., & Pauly, E. W. (1975). Federal programs supporting educational change. (Vol. 2). *Factors affecting change agent projects*. Santa Monica: Rand.

California State Department of Education. (1985). *Mathematics framework for California public schools, kindergarten through grade twelve*. Sacramento: Author.

California State Department of Education. (1992) *Mathematics framework for California public schools, kindergarten through grade twelve*. Sacramento: Author.

Cohen, D. K., & Ball, D. L. (1990). Relations between policy and practice: A commentary. *Educational Evaluation and Policy Analysis, 12* (3), 249-256.

Cohen, D. K. (1989). Teaching practice: Plus ça change.... In P. W. Jackson (Ed.), *Contributing to educational change: Perspectives on research and practice*. Berkeley, CA: McCutchan.

Cohen, D. K., Grant, S. G., Jennings, N. E., & Spillane, J. P. (in preparation). *Reading policy*.

Crandall, D. (1982). *People, policies, and practice: Examining the chain of school improvement* (Vols. 1 - 10). Andover, MA: The Network.

Gross, N. C., Giacquinta, J. B., & Bernstein, M. (1971). *Implementing organizational innovations: A sociological analysis of planned educational change*. New York: Basic Books.

Heaton, R. (1994). *Creating and studying a practice of teaching elementary mathematics for understanding*. Unpublished doctoral dissertation, Michigan State University: East Lansing.

Jennings, N. E. (1992). *Teachers learning from policy: Cases from the Michigan reading reform*. Unpublished doctoral dissertation, Michigan State University, East Lansing.

National Council of Teachers of Mathematics. (1989). *Curriculum and evaluation standards for school mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (1990). *An agenda for action: Recommendations for school mathematics of the 1980s*. Reston, VA: Author.

National Council of Teachers of Mathematics. (1991). *Professional standards for teaching mathematics—Draft.* Reston, VA: Author.

National Research Council. (1989). *Everybody counts: A report to the nation on the future of mathematics education.* Washington, DC: National Academy Press.

Remillard, J. (in preparation) *Relations among teachers, teaching, and textbooks: How teachers make sense of a reform-oriented textbook.* East Lansing: Michigan State University.

Rickard, A. (1993). *Teachers' use of a problem-solving oriented sixth-grade mathematics unit: Two case studies.* Unpublished doctoral dissertation, Michigan State University, East Lansing.

Sarason, S. B. (1982). *The culture of the school and the problem of change.* (2nd ed.). Boston: Allyn & Bacon.

Simon, M. A., & Schifter, D. E. (1991). Towards a constructivist perspective: An intervention study of mathematics teacher development. *Educational Studies in Mathematics, 22,* 309-331.

Simon, M. A. (1993). Prospective elementary teachers' knowledge of division. *Journal for Research in Mathematics Education, 24,* 233-254.

Smith, L. M., & Keith, P. M. (1971). *Anatomy of educational innovation: An organizational analysis of an elementary school.* New York: John Wiley.

Spillane, J. P. (1993). *Interactive policymaking: State instructional policy and the role of the school district.* Unpublished doctoral dissertation, Michigan State University, East Lansing.

Wilson, S. M. (in preparation). *Policymaking as inquiry.*