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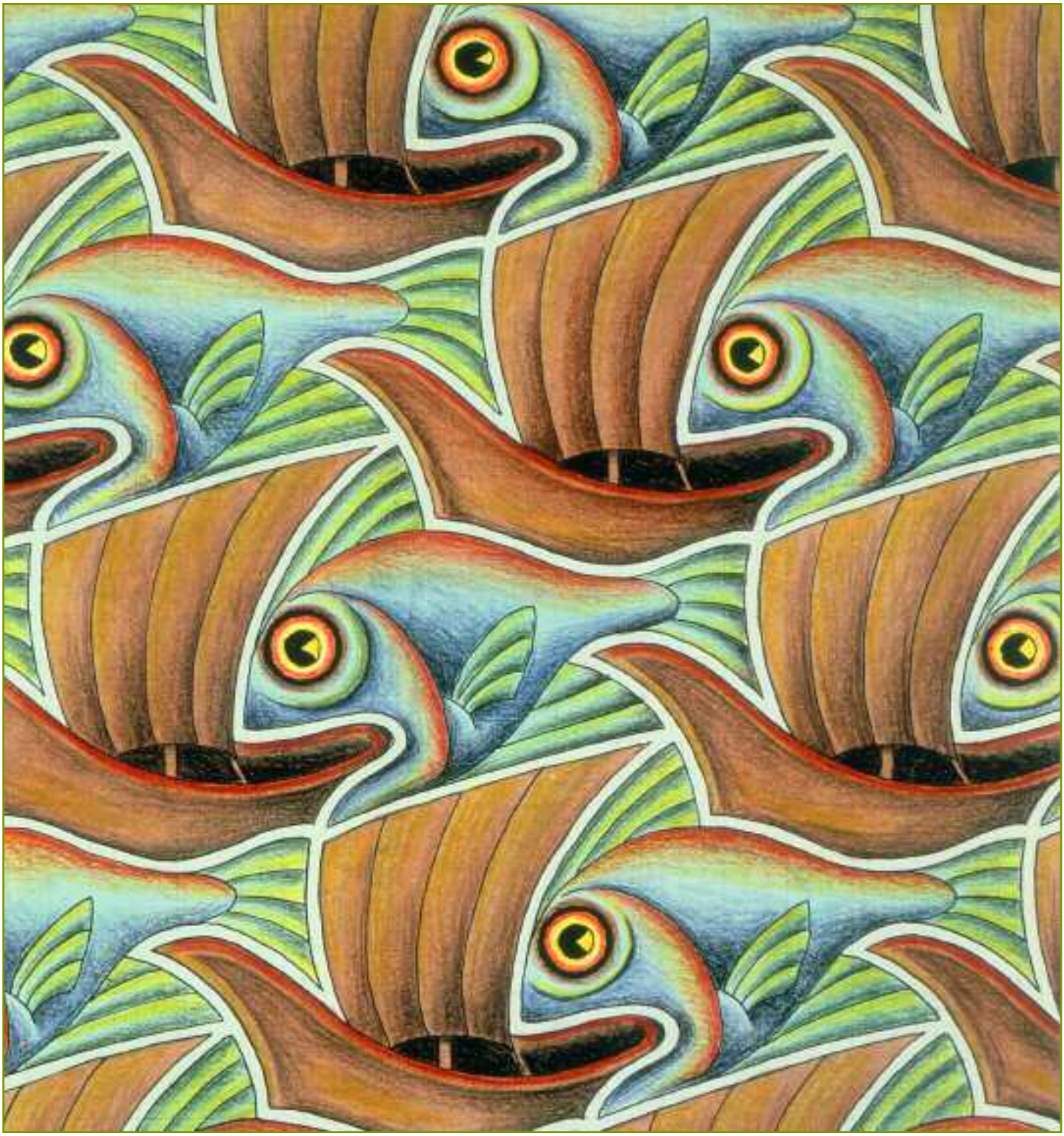

National Council of Supervisors of Mathematics www.mathedleadership.org

The ***NCSM Journal of Mathematics Education Leadership*** is published at least twice yearly, in the spring and fall.

The editors of the ***NCSM Journal of Mathematics Education Leadership*** are interested in manuscripts that address issues of leadership in mathematics education. Editors are interested in publishing articles from a broad spectrum of formal and informal leaders who practice at local, regional, national, and international levels. Categories for submittal include:

- **Key topics** in leadership and leadership development
- **Case studies** of mathematics education leadership work in schools and districts or at the state level and the lessons learned from this work
- **Reflections** on what it means to be a mathematics education leader and what it means to strengthen one's leadership practice
- **Research reports** with implications for mathematics education leaders
- **Professional development efforts** including how these efforts are situated in the larger context of professional development and implications for leadership practice
- **Brief commentaries on critical issues** in mathematics education
- **Brief reviews of books** that would be of interest to mathematics education leaders

We also invite readers to submit letters to the editor regarding any of the articles published in the journal. Selected letters will be published in the journal with your permission.

Please let us know if you would like to review manuscripts. Please include your affiliation, a brief job description, and your areas of interest and expertise.

Submission/Review Procedures

Submittal of items should be done electronically to the ***Journal*** editor. Submission should include (1) one Word file with the body of the manuscript without any author identification and (2) a second Word file with author information as you would like to see it in the journal. Each manuscript will be reviewed by two members of the NCSM Review Panel and one editor.

National Council of Supervisors of Mathematics (NCSM)

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Purpose Statement

The purpose of the NCSM Journal of Mathematics Education Leadership is to advance the mission and vision of the National Council of Supervisors of Mathematics by:

- Strengthening mathematics education leadership through the dissemination of knowledge related to research, issues, trends, programs, policy, and practice in mathematics education
- Fostering inquiry into key challenges of mathematics education leadership
- Raising awareness about key challenges of mathematics education leadership, in order to influence research, programs, policy, and practice
- Engaging the attention and support of other education stakeholders, and business and government, in order to broaden as well as strengthen mathematics education leadership.

Comments from the Editor

Linda Ruiz Davenport
Boston Public Schools, Boston, Massachusetts

As she walked down the hallway toward the fourth grade classroom, Polly glanced at her watch. Two minutes until the start of another classroom observation. She stops, hoists up onto her shoulder a book bag teeming with papers and curriculum materials, and turns to tell me one last thing.

"I explained to her," she said, "that it is a privilege to be in her classroom, to be with a teacher who cares so much about kids. I also told her that it took all the courage I could muster to tell her the truth." I said, "It isn't enough to love them and go page by page in the math book." I continued, "It's November, and we are going to have to work hard together to help you really understand the math you are teaching, and to help your students learn more deeply."

Polly hesitated again as she reached the classroom door. "Sometimes it's a thrill to be a coach, and sometimes it's so hard I just want to break down and cry—right in the middle of a grade-level meeting. Sometimes I really nail it, and other times I leave wishing I had listened more carefully. "But"—she smiled—"I keep coming back."

As I put my hand out to say thanks for allowing me to shadow her for the morning, she held my hand and said softly, "Sometimes I am stunned by how very real this work is." (Morse, 2009)

We all know that math education leadership is essential to strengthening math teaching and learning, especially as we consider what it means to teach for understanding, build mathematical proficiency, and help every student take on practices like those described in recent drafts of the Common Core Standards for Mathematics.

But as anyone who has worked with our schools knows, math education leadership is a complicated and multifaceted undertaking. We know it takes cultivating teacher leadership at both the school and district levels, whether these leadership roles are formally designated—like the role of a math specialist or math coach—or whether these roles are informal, as in the case of teachers who open their classrooms to colleagues or who support rich and focused discussions during grade level team meetings. We know it takes instructional leadership from the principal or headmaster because we know we need their support in creating schedules that allow teachers and teacher leaders to collaborate, in communicating the importance of participating in professional development, in setting norms around expectations for *all* students, supporting a positive school climate where student thinking is valued. We know there are others whose leadership in math matters as well —district administrators who make policy decisions that support or may inadvertently undermine math teaching and learning, parent leaders who lead the parent community in advocating for high quality math teaching and learning, as well as the roles of important stakeholders from the community. We can name this math leadership work, and even describe it, but what does it take to do this work well?

Currently there are a number of resources containing cases of math teaching practice designed to provide us with opportunities to examine and discuss multiple images of high-quality math teaching and learning (e.g., Boaler & Humphreys, 2005; Fosnot & Jacob, 2010; Grant et al., 2009; Schifter, 1996; Schifter et al., 2007; Seago et al., 2004; Smith et al., 2005; Stein et al., 2000). These create images of teaching and learning "in action" that help teachers imagine other possibilities for their classrooms and provide a context for digging more deeply into questions of what it means to teach math in meaningful ways.

Many resources currently exist to support math education leaders as they work to strengthen mathematics teaching and learning in classrooms, schools, districts, and even at the state level. One important example is the *PRIME Leadership Framework: Principals and Indicators for Mathematics Education Leaders* (NCSM, 2008). Here we find descriptions of important leadership principles within the following four domains—equity leadership, teaching and learning leadership, curriculum leadership, and assessment leadership—along with indicators of leadership in each domain along with specific actions that might be associated with each. Together these make up a useful framework for shaping a strong math leadership practice. But what does this look like in action? How might we learn from the experiences of others who are taking on this challenging but very important work? But we have fewer *cases* of math leadership practice (e.g., Carroll & Mumme, 2007; Morse, 2009; West & Staub, 2003) that provide us with images of what this looks like in action and help us strengthen this work as well.

It is my hope that this journal will help provide the kinds of rich images of math education leadership that can help us reflect on and strengthen our practice, regardless of its particular context. In this issue, you will find articles that we hope will convey just those sorts of rich images. In *Curriculum Leadership in Selecting Mathematics Materials,* we have opportunities to consider the pros and cons of taking a less or more active role in shaping decisions made by curriculum adoption committees. In *Supporting the Transition From Experienced Teacher to Mathematics Coach*, we can think about what it means to go from being an "expert" teacher to a "novice" math coach, and what supports might be needed to prepare teachers for this transition as well as supporting them through the transition itself. In *Principals' Views of Mathematics Teacher Learning*, we learn about how principals think about and plan to address school situations where the math teaching and learning is not sufficiently strong—and how they make decisions about what kind of professional development supports might be needed for these teachers. In *A District Math Leadership Team: Deepening Collective Focus*, we see what it took for a district to create a cohesive and comprehensive K-12 Math Plan—bringing together a number of key stakeholders who did mathematics together, visited classrooms together, examined student data together, and considered what needed to be in place to ensure strong mathematics teaching and learning for all its students.

As you read through these articles, we hope you will find stories that resonate with your own math education leadership work. Please let us hear back from you about connections you are finding, things you are now thinking about more deeply or in a different way, or steps you plan to take because of something you read here. In the next issue we will have a new section called *Comments from Our Readers* and we hope to be able to share any reflections you might send us with our math education leadership community.

Also in this issue of the journal you will find the Commentary on Critical Issues in Mathematics Education *What About the Assessment Gap? We Need to Address it—Now!* This piece raises important questions about the role and impact of large scale assessments, and is particularly timely now that the Common Core Standards are about to be released, with all the ongoing conversations taking place about what it might mean to assess these in meaningful ways. Please let us hear about your thoughts on the issues raised for you here as well.

Also as you read through the articles in this issue, it might be interesting to consider how important it is for the various aspects of our math education leadership to fit together to create a cohesive and comprehensive whole, much like the tessellation created by MC Escher on the cover of this issue. Whether you are a teacher leader, a math specialist or a math coach, a principal or headmaster, a district administrator, a leader from the parent or business community, or some other stakeholder taking on a leadership role, the more closely and seamlessly we can all work together to strengthen math teaching and learning, the more success we will be able to achieve.

We hope you enjoy the issue!

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Curriculum Leadership in Selecting Mathematics Materials

Deborah Spencer, June Mark, Julie Koehler Zeringue, and Katherine Schwinden
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Ann Foster walked down the aisle of publishers' booths at the National Council of Teachers of Mathematics regional conference in October, looking at the textbooks on display. In her new role as curriculum coordinator in the Riverside School District, Ann was responsible for overseeing the selection of new K–12 mathematics materials this year, and she expected it to be a challenge. The Riverside schools were deemed "in need of improvement" by the state's standards —with test scores falling just below the state's "effective" rating—and Ann was feeling great pressure to increase those scores. The current math textbooks weren't, in Ann's opinion, very well aligned to the state standards (and consequently, not very well aligned to the state test) and Ann had been looking forward to this year's opportunity to purchase new materials. She was particularly interested in some of the more innovative programs being used in a few neighboring districts, where they seemed to be having some success. However, the teachers in Riverside seemed largely satisfied with the textbooks they had; Ann suspected they would prefer the district buy the updated editions of their current textbooks. The K–12 materials selection committee —comprised of Ann and representatives from each of the Riverside schools—would begin meeting next week.

Ann has many questions about how to make a wise choice of materials. She believes that, in her district, textbooks play an important role in shaping what happens in the mathematics classroom, and therefore need to be chosen carefully. But what textbooks would be best for students' learning? What options should they consider? How would they know if they were effective? Who should be involved in choosing the new materials? Once chosen, how could she ensure that teachers would use them? What support would she need to provide to assist teachers in using the materials well? Where should she start? Ann and thousands of her colleagues across the country face similar questions each year in the process of choosing new instructional materials in mathematics. This article reports on a study[1] investigating the mathematics textbook selection process, discusses the role that curriculum leaders like Ann play in making those decisions, and offers an opportunity for mathematics supervisors to consider their own leadership in the textbook selection process.

How Do Districts Choose Mathematics Textbooks?

In order to understand the complexities and realities of how districts select mathematics instructional materials[2], we interviewed 150 K–12 mathematics curriculum decision-makers from districts in eight states. The states—Colorado, Louisiana, Maine, New York, Ohio, Texas, Washington, and West Virginia—represent a mix of state-adoption states (in which the state provides a list of approved textbooks and a timeline for adoption) and open-territory states (in which the choice of textbooks and timeline for selection is unrestricted by the state) across the country. The districts we selected for interviews within

[1] The authors are grateful for the National Science Foundation's support of the project, Effective Use of Mathematics Instructional Materials (Grant No. ESI-0454022) of which this study is part. Opinions expressed are those of the authors and not necessarily those of the Foundation.

[2] Although we recognize the potential for the terms mathematics instructional materials and textbooks to have different connotations, for the purpose of this paper we use them interchangeably.

each state reflect a range of characteristics in terms of performance level, geographic region, percent of students in poverty, size, and textbooks used.

Our interviewees were, in most cases, the person in each district directly responsible for overseeing the selection of new mathematics textbooks. They were typically mathematics supervisors, curriculum coordinators, department chairs, and assistant superintendents. Half of our interviewees were mathematics specialists; the other half held positions that cut across disciplines. For simplicity's sake, throughout this article we refer to these interviewees collectively as "curriculum leaders" though none held this title officially. Across our interviews, we sought to answer the following questions:

- What processes do school districts use in selecting mathematics textbooks?
- What factors shape those decisions?
- How does textbook selection differ in state-adoption and open-territory states?
- What research do curriculum leaders find most useful in textbook selection?
- What questions about mathematics textbooks do decision-makers need answered?

The curriculum leaders we interviewed described in detail the processes they used in choosing mathematics textbooks in their districts, as well as the influences on the design of those processes. The interviewees were, in general, thoughtful and thorough, and we are grateful for the candor and ease with which they discussed with us aspects of their jobs, their thinking, and their challenges. Their stories, out of necessity, often went beyond a strict focus on textbook adoption—as in many cases their efforts in these areas were intertwined with their strategy for improving student learning in mathematics—and they were generous with their explanations of how instructional materials related to their overall mathematics programs. It became very clear to us, through the interviews, the seriousness of purpose with which many curriculum leaders take their duties with respect to textbook selection. We found that most districts in both open-territory and state-adoption states follow an organized selection process with some complexity and substance. This finding may run counter to the popular perception that many textbook selections are made with little thought or effort; we found the opposite to be true.

The data gathered in these interviews has been supplemented by other sources, including a survey of the members of the Association of State Supervisors of Mathematics; a series of surveys of curriculum leaders nationally conducted by our collaborators at Inverness Research Inc.; an investigation of state-level documents and websites; and a review of the relevant literature. This data was analyzed first for each state individually to identify themes and hypotheses; we then looked across states to identify a set of claims in six key areas: (1) typical district selection processes; (2) the role of the curriculum leader; (3) factors that influence mathematics textbook decisions; (4) curriculum leaders' use of research and resources; (5) the role of instructional materials in mathematics improvement; and (6) supports for implementation. We then coded each interview, as well as the survey results, organizing the data available to confirm or disconfirm each possible claim. That coding also allowed us to identify the particular rationales offered by interviewees for their decision making.

This article offers primarily a discussion of our study's findings about the role of the mathematics curriculum leader in textbook selection, although we also touch on other areas.

The Role of the Curriculum Leader

The activities of curriculum leaders look remarkably similar, on the surface at least, across the variety of district contexts and grade levels we studied. The curriculum leaders we interviewed were, by definition, that person in each district responsible for designing, coordinating, and facilitating the selection process for new mathematics instructional materials. In a typical selection process in our study, the curriculum leader worked closely with an appointed committee, composed largely of teachers at the affected grade level, over a period of about one school year, to:

- ***Prepare for the selection process***, by reviewing district and state requirements, goals for the process, relevant district data, and recommendations from the field;
- ***Narrow the options*** by creating a "short list" of textbooks for evaluation;
- ***Evaluate those options*** in detail, by using established criteria, reading relevant reviews, visiting schools using the textbooks, and/or piloting the materials;
- ***Decide on a recommendation***, by consensus or by official vote; this recommendation almost always requires school board approval.

There were a number of commonalities in the role that curriculum leaders played in this typical process. This leadership role included such activities as inviting or appointing committee members, setting and sharing the criteria for selection, preparing teachers to participate in the process, identifying relevant research, and presenting the final choice of materials to a school board for approval.

Most curriculum leaders—about 80% in our study—collected and shared some information and resources to support the selection process. That effort took many different forms including researching potential options, identifying and sharing research on student learning of mathematics, finding efficacy studies on different program options, and collecting data from other districts on the use and effectiveness of the materials.

In addition to orchestrating these aspects of the process, leaders in our study saw one important aspect of their role as helping to keep the selection process focused. They did this by, for example, helping to orient the committee to what was important in the process:

> Before we looked at any materials we did a lot of research on standards-based mathematics. We had some speakers come from the state department to talk some about what's standards-based mathematics looks like…. And the elementary and middle school teams voted before we even began looking at materials, to only consider the ones that were standards-based materials.
>
> — *Curriculum and Technology Specialist*

Curriculum leaders also emphasized the importance of establishing criteria for selection. Such criteria, used by over 65% of our interviewees, helped keep committee members focused on essentials, rather than "neat features" of the books or freebies and gimmicks offered by publishers.

> When they [publishers' representatives] come in and they start showing you all the bells and whistles of their product, it's like, "Oh, we want it all! … You know, "Just give us everything." But when you're looking for those very specific criteria, we just had to say, "This one just does not have that."
>
> — *Assistant Superintendent for Instruction*

> We only look at the manual itself, the teacher's manual. We don't look at all the ancillary stuff. Because a lot of times teachers get distracted with the ancillary stuff. So we look at the textbook itself, the manual. If that gets us what we want, then we consider the others. But the other [stuff], that's the gravy.
>
> — *Assistant Superintendent, Curriculum and Instruction*

While virtually all of the leaders we interviewed were responsible for overseeing the choice and implementation of mathematics materials, as described above, there were significant variations in their roles. Some of these differences were directly related to their district context. The selection process in very small districts, for example, was much more likely to be informal, with less committee work and more choices made by individual teachers following fairly loosely-established criteria. In state-adoption states, the process was much more likely to be constrained by state guidelines that might dictate committee composition, prescribe particular selection criteria, or insist upon equal consideration of all vendors as a protection against corruption. Some districts in open-territory states had processes equally constrained by such policies, as a result, for example, of a union agreement that dictated textbook selection policy.

Beyond the influence of district and state context, the curriculum leaders we studied varied significantly in their choice of whether to reveal their own professional judgment in the evaluation of materials and to advocate for their preferred choices or to remain neutral with regard to the materials selected. This difference in approach is discussed in detail below.

Advocacy and Neutrality of the Curriculum Leader

One significant variation that we found in the role of the curriculum leader was the extent to which they chose to reveal their own perspective on the choice of instructional materials. This variation in role was dependent on restrictions in a leader's state or district context, and also appeared to be influenced by the individual's beliefs about the role of instructional materials. In our study, there were leaders who believed that the particular choice of materials was critical to the improvement of their mathematics programs, and accordingly, demonstrated greater advocacy within the selection process. However, there were also leaders in our study who chose to remain neutral in the selection process, leaving the particular choice of instructional materials to a teacher committee; this approach reflected a belief that the particular choice of textbook mattered less than the opportunity to build teachers' commitment to the materials selected.

What we found was a continuum of roles that curriculum leaders assumed in the process. We offer the following characterizations of leaders on this continuum with respect to their advocacy in the selection process. These characterizations include curriculum leaders who:

- ***Manage the selection process***, but maintain a neutral stance in the evaluation of materials and leave the decision to the appointed committee. Based on our data we estimate this to be about 30% of our curriculum leaders with this characterization being over twice as common in state adoption states
- ***Participate actively in the process***, offering professional expertise in the evaluation of materials, but leaving the final choice of materials to the appointed committee. According to estimates of our data, this is the most typical characterization, with 45–50% of leaders falling into this category.
- ***Advocate for particular materials or approaches***, on the basis of their professional expertise, and may in fact decide on the final choice of materials or greatly limit the options available to the appointed committee. We estimate that 20–25% of our curriculum leaders overall fit this characterization (although the approach was less common in state adoption states, with fewer than 10% of those leaders in this category).

We describe these three approaches in more detail below.

The curriculum leader manages the selection process, but maintains a neutral stance in the evaluation of materials and leaves the decision to the appointed committee.
Often, the role of leaders in this group during the selection process is defined by school board policy, which is in turn influenced by state policy or other restrictions that dictate that the choice of instructional materials must be made by a committee of teachers, or determined by teacher vote. Leaders in this group tend not to express their own personal preferences in the committee, believing that the process should be teacher-driven, and that their neutrality in the process is important. A mathematics supervisor describes her involvement in the selection committee:

> Now, they had some debates within their groups, but I stayed out of them. I did hear the discussions. But again, I stepped aside from that. I let them have that discussion… Tell me what you want. If they wanted to adopt one publisher, that was fine. If they wanted five different publishers, that was fine with me… And I told them that was not my objective, that I was not saying which way they needed to go… Because I wasn't the one that was going to be directly in the classroom using their book, they were. And as a result, I think they took me at my word, because we adopted four different publishers [for different high school courses], I think it is.
>
> — *Mathematics Supervisor 9-12*

Another curriculum leader related how school board policies specified the teachers' role in the decision about materials.

> We followed school board policy. And that was that a textbook committee would be formed, which we did. We had representatives from all six secondary campuses on our textbook committee. It also specified that teachers would have a say, up or down, in the final decision… We allowed every teacher to vote within their campus, and then there was a representative from the campus who came and represented that vote in the textbook hearing… And all that was kept in minutes and notes… As Curriculum, we facilitated the process but we did not really put our two cents into what book we thought was better. And quite frankly, the teachers were in a better position to make that determination anyway. They were the ones using the materials in their classroom to see what worked with their students. And while I attended textbook hearings, our director was very clear about the fact that he didn't want people to come back and say, "Well Curriculum picked the books for us." He wanted it to be a very good process where the teachers had most of the input.
>
> — *Secondary Mathematics Director*

In both of the examples above, the curriculum leader felt strongly that teachers should be making the decisions about instructional materials, because of their classroom expertise, and because they were ultimately the users of the chosen textbooks. In the second example, we see that the rationale for that stance included adhering to board policy, and a desire to avoid any perception of bias in the decision. The leaders in this group see their role largely as organizational and logistical and are committed to following district policy —ensuring that teachers have a strong voice in the process, that the process is fair and unbiased, and that the committee has what it needs to make a good decision. Given that it is much more common for state-adoption states to have policies in place that govern the textbook selection process, it was not surprising that this approach was more prevalent among curriculum leaders from state-adoption states.

Curriculum leaders who maintained a neutral stance in the selection process—not revealing their own perspective, nor relying on their own professional expertise in curriculum—still assumed leadership for planning and leading implementation activities. Critical implementation activities included ordering books, arranging professional development, designing implementation plans, and aligning the selected textbooks with district and state standards

The curriculum leader participates actively in the process, offering professional expertise in the evaluation of materials, but leaves the final choice of materials to the appointed committee. This was the largest group among the curriculum leaders we interviewed. These leaders may play a very active role, particularly in the early phases of the process, helping to orient the committee by sharing research on best practices for teaching and learning mathematics and articles on different curricular options, designing evaluation criteria, and keeping the committee focused and moving forward. They may share their own experiences and expertise about the instructional materials being considered but usually do not try to limit the committee's choices or make the final decision on the choice of materials. Their neutrality in the later stages of decision-making may come from a commitment to making a consensus decision, a wish to avoid perceptions of undue influence, or a desire to build teacher commitment to the choice of materials—believing that the latter is critical for effective implementation.

In the following two examples, the curriculum leaders view themselves as working collaboratively with the selection committee, but choose not to influence the final choice of materials.

> My role was really the facilitator, the person who attempted to set the tone for what to look for. The person who pulled people together for conversations and held them accountable for looking in depth and not just superficially at the material… Now our board policy, and from what I get a sense of, certainly in my previous district the same thing, it spells out that it is a teachers' selection process. So while I'm advising and pushing and providing as much possible light as I can on those materials that I feel are the best, it's still a teacher selection committee… I think it's a system of checks and balances to prevent districts from going with a coordinator's choice because possibly the coordinators had some hand in developing some materials. To keep it really egalitarian and keep it populist… If it's a collaborative decision I think those materials then have a better shot of being used and used wisely.
>
> — *Secondary Mathematics Coordinator*

> Well, my role is around curriculum, instruction, assessment, and I facilitate that group along with all the other curriculum groups. And hopefully I'm listening well and helping them make good decisions. I don't like to be that final decision. I want it to be truly what they seem to want. If we really have an issue around it, then perhaps the superintendent and I will work it out. But hopefully we try to facilitate the group in such a way that we really come to a consensus together.
>
> — *Director of Curriculum*

In the two examples above, the leaders clearly played a critical role in setting the tone of the discussions about the goals and materials considered in the process but limited their roles in the final decision-making because of a commitment to make a collaborative decision. This desire for consensus was driven in part by an acknowledgment that teachers' input is essential for effective use and implementation.

These curriculum leaders were often more willing to share their perspective or advocate for a particular instructional approach in the preparation, narrowing, and evaluation phases of the selection process, but assumed a more neutral stance in the final choice of materials.

> I don't want anybody to say, 'This is the program XX wanted.' I think it's more important for teachers to say, "This is the program teachers of the district wanted." I really feel strongly about that; it has to come from them. I'll certainly help coordinate and tell them programs that I know about, any research that I've done, or neighboring districts that have good test scores, you know I'll investigate that for them and find out the book and get the consultants in. But, to say this is the one I think is best, I won't do that.
>
> — *Mathematics Curriculum Coordinator*

Curriculum leaders in this category expressed reluctance to adopt materials that teachers did not find appealing—even if they believed those materials would provide a better student learning experience. They saw themselves as able to influence the selection process, but limited that influence, protecting the process as teacher-driven and attending to teacher preferences and judgments about quality of materials.

The curriculum leader advocates for particular materials or approaches, on the basis of their professional expertise, and may, in fact, decide on the final choice of materials or greatly limit the choices available to the appointed committee. The leaders in this group see it as their responsibility to share their professional expertise and judgment with the appointed committee. Therefore, they share their experiences with particular programs or instructional approaches, and view their role as contributing knowledge and information that would enable the district to make the best choice of materials for their students. These leaders described instructional materials as playing a critical role in their districts' mathematics program, and therefore, viewed the selection process as an important opportunity to improve mathematics instruction and learning.

In the selection process, these leaders' actions might include actively researching curriculum options; limiting the committee's choices to programs that take a particular approach; offering their opinions on and evaluations of particular programs, and in some cases, making the final choice of materials. In our interviews, these curriculum leaders described themselves as responsible for being knowledgeable about the research on student learning of mathematics, and on the effectiveness of various instructional approaches and curricular materials. Often, these leaders actively connected to colleagues in other districts and at regional and professional organizations, collecting data from other districts about their experiences with particular materials and their effectiveness for students and teachers.

It is important to note, however, that the interviewees who described an advocate approach to leadership did not disregard the input and commitment of the teachers with whom they worked. In general, they described going to some length to build teachers' commitment to the materials, by detailing their rationale for a preferred program, offering opportunities to pilot the program, or offering a choice of two similar programs. But their approach to textbook selection was driven primarily by attention to student outcomes, rather than teacher preferences.

In the following example, a curriculum leader described her role as an advocate in the selection process.

> Then what I did is I had a math curriculum committee, and I just got them talking… And it was grade level representatives. So we had a K rep, a One rep, you know, etc., etc.… And basically we talked about what we're doing and why we're doing it, and I was very blunt. I used [test] scores to show that we were in trouble mathematically. You know, you go to the data, and I said, "Woo, folks. We're walking this thin edge of barely meeting [state requirements]." And what we did is we started talking about… I encouraged some piloting. I wanted people to get, you know, dirty with whatever's out there. And I started getting concerned because, you know, I had too many people wanting to do a newer version of what they were using… I just said, "Why don't we just pilot the best of the best out there?"… And we piloted [two] this year…
>
> — *Curriculum Coordinator*

This curriculum leader used test data to build an argument for changes to their curriculum and instructional approach, and then narrowed the choice of pilot materials to the consideration of just two programs. Another leader described her thinking about her role in the process in the following way:

> My style is not to do the old style where we bring in seven publishers and they all get 20 minutes with the staff, and then we vote. We don't do that anymore. I work hours and hours behind the scenes doing research, reading what best practices in math are, what do we need to be looking for. What programs are successful where students are achieving well? And I look at the NSF projects, those are always high. What is the NSF saying about that? … I do the web searches now, and after awhile you begin to see some patterns emerging where the academic achievement of students, what mathematicians and people in that field are saying are good programs at this time. I gave the teachers, then, two choices. Trailblazers was one company; Everyday Math, they kind of get at the same thing with different companies. And then they chose …
>
> — *Curriculum Supervisor*

Several interviewees described this approach as a change from a previously more neutral leadership approach, as does the interviewee above. This approach appeared to be emerging in response to increased accountability and growing urgency over improving student outcomes. Often, the curriculum leader's advocacy was paired with a move toward centralizing curriculum decision-making at the district level, as in the example below.

> We have been a district in "academic difficulty" since the designation was created. And part of the reason that we were there was because schools made those decisions

> locally. Every school had a different reading program. Every school had a different math program. There was no accountability…. Since the district was being [held] accountable for our rating, we needed to be accountable for the programs we were to implement. And so we changed that at the district. Five years ago we said that we would decide on the core programs in reading, math, science and social studies, what those materials would be. And we would be able to, then, better support the professional development that went along with that. And then we could do our own in-house assessments to see how well students were doing, and then we could make schools accountable for the implementation.
>
> — *Assistant Superintendent*

These curriculum leaders reported using the selection process as an opportunity to create greater consistency and greater coherence across grades K–12 in their district mathematics programs. They believed that a common textbook selection would ensure that teachers across a district are using materials closely aligned with state standards and test requirements and would enable a district to provide professional development linked closely to those materials. Consistent use of the adopted instructional materials and greater accountability for teachers' uses of the materials (e.g., through the use of common unit, quarterly, and benchmark assessments and pacing guides) would result in greater equity in learning opportunities in mathematics for all students.

We found leaders exercising greater advocacy in the process more commonly in open-territory states than in the state-adoption states in our study. We believe this is partly due to less restrictive policies, which would allow this approach. Also, in open-territory states, districts make selection decisions on different timelines, making it possible for curriculum leaders to observe the use of materials being considered in neighboring districts and to learn from the curriculum practices of other leaders.

Conclusion

Across these different approaches, virtually all of the curriculum leaders we interviewed acknowledged the importance of teacher input in the selection of textbooks, and viewed teacher commitment to the selected materials to be an important element of successful implementation. For many curriculum leaders, this led them to design selection processes that were highly dependent on a teacher committee's preferences and judgments about the quality of materials. In those processes, curriculum leaders either remained neutral or played a limited role in the evaluation of materials, depending on the restrictions of the district or state context. A significant minority of interviewees, however, described a different approach, in which they used their expertise in curriculum to identify and evaluate potential textbooks, offered opinions and professional judgments, and actively influenced decision making. These leaders were motivated to do so by an urgent need to improve student outcomes and by a belief that instructional materials could play a substantive role in doing so. They also operated in district and state contexts where this kind of advocacy was possible. Those processes were driven primarily by judgments about the quality of materials and their relative likelihood to influence student outcomes.

Regardless of their particular approach, curriculum leaders in our study were trying to meet and balance three important goals:

- The first goal was to ***determine which materials were the best fit*** for their mathematics program. Districts pursued this goal by checking textbooks' alignment with state standards; by establishing criteria for quality and analyzing textbooks accordingly; by reviewing student data to determine areas of need; and by looking for evidence—through piloting, research, or independent evaluation—of quality.
- The second goal was to ***build teachers' commitment*** to using the new textbooks. Curriculum leaders argued that if materials were not appealing for teachers to use—or if teachers did not believe they have input into the choice of materials—implementation would be less effective.
- The third goal was to ***ensure that the process is fair and transparent***. Districts protected against bias and corruption by seeking input from a range of stakeholders, considering multiple options, establishing criteria for evaluating textbooks on their merit, and looking for independent data as evidence of quality.

Each leader made deliberate choices about the design of the process based on the relative importance they placed on these three goals, influenced by their state and local contexts and their beliefs about the role that instructional materials should play in a mathematics program. Some leaders felt very strongly that it was their job to narrow the list, ensuring a choice of high-quality materials. Others felt their role was to prepare a committee and let involved

teachers make a consensus decision, building teacher buy-in. Still others were very careful to make the process as fair and transparent as possible. Regardless of which particular choices were made, what was clear in our study was that curriculum leaders had opportunities to make strategic choices about textbook selection and implementation and to use the process as a means for improving their mathematics programs. Those choices included:

- How selection committees are prepared to participate in the process;
- What criteria are used for evaluating the quality of mathematics textbooks;
- What role teacher input plays in the process;
- Whether the curriculum leader advocates for a particular approach or program;
- Which sources of information and research are introduced in the process;
- Which textbooks make the "short list" for further evaluation;
- How newly selected textbooks are implemented and supported; and
- How schools and teachers were held accountable for implementation.

As a curriculum leader you will likely find yourself in the position of facilitating the selection of new mathematics textbooks in your district. Whether that selection process is driven by pressures to raise mathematics achievement, to meet new state standards, or simply the need to replace old books, it brings with it the opportunity to improve your mathematics program. As you think about the decisions made by the curriculum leaders in our study, consider your district and the opportunity you have to use the adoption of new instructional materials as a vehicle for improvement of your mathematics program. What choices will you make about the selection and implementation of mathematics instructional materials in your district? Can you use the selection process to bring greater coherence to your district mathematics program, maximizing the potential contribution that new textbooks can make in mathematics program improvement?

Supporting the Transition from Experienced Teacher to Mathematics Coach

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Educators who transition into new positions with little to no experience often face challenges. Interestingly, most teachers acknowledge the challenges they faced as first-year teachers. Yet, we do not always hear about the challenges faced by novice teacher leaders or mathematics coaches. Too often, we assume that effective teachers will be effective coaches, and that these teachers need little support as they transition into new roles as mathematics coaches. This naïve assumption poses a problem. As experienced, accomplished teachers, they have many skills and much knowledge about teaching. However, when these experienced teachers become mathematics coaches, they become novices again—a space that is very uncomfortable and often confusing to navigate. Transitioning from mathematics teacher to instructional coach requires more than just acquiring additional competencies (e.g., the abilities to work with adult learners, facilitate grade-level meetings, provide feedback to other teachers about their practice, or deal with resistance to change). It also requires, among other things, negotiating new aspects of relationships with long-term colleagues, facing emotional challenges that are different from the emotional challenges of teaching, and organizing the work day in different ways.

Understanding this critical transition is important for facilitating the development and support of effective mathematics coaches. Mathematics coaching has the potential to influence the professional growth of teachers, and ultimately the classroom experiences and mathematics achievement of students. This potential for influence can only be realized if novice mathematics coaches are supported to develop the necessary knowledge bases to effectively do the work of coaching. Moreover, they must be supported to acknowledge and address the challenges they will undoubtedly face.

Just as the education community seeks to develop certain knowledge, skills, and dispositions with K-12 teachers, we contend that mathematics coaches, particularly those in transition from classroom teaching, must develop new knowledge, skills, and dispositions about leadership and coaching. It should not be assumed that excellent teachers will be excellent mathematics coaches. We need to be purposeful in assisting classroom teachers' transition into these roles and positions. Therefore, it is critical to create structures and processes to identify, prepare, resource, and support mathematics coaches. The purposes of this article are to:

1) inform administrators and mathematics coaches about the challenges associated with transitioning into mathematics coaching roles, and 2) make recommendations about support structures to address those challenges.

Our Context

We have worked with mathematics teacher leaders for a number of years in both informal and formal settings. Informally, we supported a local district's Mathematics Leadership Group (i.e., curriculum coordinators, school-based teacher leaders, and full-time K-7 mathematics coaches) by providing professional development, consultation, and a connection to the research literature. More formally, we taught graduate courses about teacher leadership and mathematics coaching, facilitated Leadership Academies for mathematics teachers, and conducted research studies focused on leadership in mathematics education. As we worked with leaders in all of these contexts, we came to recognize that new leaders face a number of common challenges, particularly as they assume leadership

roles at the department, school, and district levels. Armed with our anecdotally-based observations, we took the opportunity to design and conduct a research study with a group of 14 first-year mathematics coaches in one small school district (student population of ~17,000 in grades K-12).

The first-year mathematics coaches who participated in this study were all experienced teachers (11 elementary teachers and 3 middle-grade teachers) who had taught in this school district for many years. Each of these first-year coaches had been identified as particularly "effective" mathematics teachers and were, after a competitive application and interview process, hired to be a full-time mathematics coach (with no assigned teaching load). Of the 14 new mathematics coaches, 12 were female and 2 were male. Eight of the coaches were assigned to support two K-5 schools, three coaches were assigned to support one K-5 school, and three coaches were each assigned to a different middle school.

For this study, we collected data using multiple sources. First, all of the coaches completed a survey that contained items focused on their background experiences (e.g., teaching, university coursework, and professional development). The coaches were also asked to describe characteristics of effective and ineffective professional development. In addition, the coaches responded to questions such as, "What skills and knowledge would help you be an effective mathematics coach in your school(s)?"

Coaches also participated in two semi-structured interviews during their first year; one in the fall and the second in the spring. The first interview was designed to probe coaches' perceived preparation for mathematics coaching, their expected roles and responsibilities, as well as the anticipated challenges and desired supports. The second interview was reflective in nature and designed to follow-up on questions asked in the first interview.

We also attended the monthly district-wide coach meetings, where we collected two types of data: responses to written prompts and audio-recorded, whole-group discussions. At each monthly meeting, coaches spent approximately 20 minutes writing individual responses to researcher-generated prompts (see Figure 1 for sample prompts). Then the researcher facilitated a whole-group discussion about those prompts. These whole-group discussions were audio-recorded.

FIGURE 1. *Sample writing prompts.*

- Think about unanticipated situations that you have faced as a mathematics coach. Choose one of those situations and respond to the following prompts:
  1. Describe the situation.
  2. Describe how you responded to the situation.
  3 Describe any support you sought out to help you with this situation.
- Think about a challenging situation that you have faced as a mathematics coach. Choose one of those situations and respond to the following prompts:
  1. Describe the situation.
  2. Describe how you responded to the situation.
  3. Describe any support you sought out to help you with this situation.
- Think about your role as a teacher of mathematics. Now think about your role as a mathematics coach. In what ways are these roles similar? Different?
- Think about all you do as a coach in a "typical" week. Use the circle below to represent what you do as a mathematics coach and the amount of your week you spend doing each activity. (In other words, create a pie chart that describes your work as a math coach in a typical week.) Below the circle, provide a "key" for the parts of your circle. For example, if you have "observing teachers" as a piece of your circle, describe the specifics of what you do during that time.
- What was your initial vision of your job as a math coach in the district? How did you deal with differences between your initial vision of your job as a math coach and the actual experience as a math coach?

Challenges for New Mathematics Coaches

In this section, we present five different challenges that these mathematics coaches faced as they transitioned from experienced teacher to novice mathematics coach. Our data analysis indicated that these novice coaches faced challenges that they expected and others that they did not expect. Although the coaches were placed in different schools across the district, their challenges were surprisingly similar.

ENHANCING KNOWLEDGE BASES AND BROADENING VIEWS

Often mathematics coaches are identified for leadership roles due to their success as classroom teachers. The knowledge needed to be a successful classroom teacher; however, differs from the knowledge base necessary for successful leadership. The ways that they have learned to communicate with students, for example, is very different than the ways that they now need to communicate with adults on a daily basis. In addition, mathematics coaches need to have knowledge related to a wide variety of areas beyond "coaching" (e.g., school improvement, adult learning, addressing conflict, scope and sequence of mathematics across grade levels, and leading individuals with different personality types). Often, novice coaches are not cognizant of what they need to know in order to do their jobs effectively, as expressed by Rebecca in her fall interview:

> If you don't know what you're looking for, if you don't know what you don't know, then you have a problem—which is kind of where I was [prior to school starting]. I'm moving a little past that. It's astounding the things that I don't know.

Farah expressed the same sentiment: "I can't even tell you all the things that I need to learn because there are too many, and some of them I don't even know what they are, yet."

Other coaches spoke of very specific knowledge that they felt they needed to have to be an effective coach. For example, Ilene spoke about her need to build knowledge of mathematics that was being learned across the grade levels: "Learning more about the curriculum—sometimes it's difficult to drop in and know what's happening and to know if the math coming out is significant." Uma said,

> I knew what I had done in my classroom, but I didn't know anything about leadership. I didn't know where the math was going. I didn't know anything about (National Assessment Data) . . . that's background knowledge that you need to be effective [as a coach].

The coaches also indicated that they needed to learn how to deal with teacher resistance and unprofessional teacher behavior (e.g., lying about availability, stating that they didn't need help). The coaches did not know "how to coach," including what questions to ask teachers, how to challenge teachers' thinking, and how to focus conversations on mathematics. They wanted to know how to build a teacher community and better facilitate grade level meetings. For example, Farah stated, "I think I need to learn a lot about, it's that ongoing journey of learning how to be with people, all people–how not to get frustrated when people are real resistant, or afraid." Still Rebecca said, "Since I've become a coach of mathematics, I feel . . . there's still a ton to focus on: content, supporting adult educators, keeping up on most recent research, planning, modeling, and reflecting with teachers." While Barbara stated:

> I want to know if there's a model, some kind of setup. I know they keep saying, 'going to be different with the teacher, with the school,' but I wish there were best practices that we have for teaching. We know about questioning and we know about modeling, and we know about all that. I want something like that for a math coach. I want to know how to be more effective, or to be as effective as I can. I've read books about what to do as a math coach, and I've tried that, but I still don't think I really know.

In addition, these new coaches talked about having to broaden their views from the classroom level to a school/district level. New coaches face the challenge of "seeing" familiar situations from a new perspective. Teachers are typically not aware of the differences in instructional practices that exist in a school. In addition, new coaches are often asked to examine school-wide achievement data for particular subjects, identify areas for improvement, and then work with specific teachers to address those areas. They may be called upon to serve on district-level committees, requiring a perspective on decision-making at a district-wide level, rather than the classroom or school level. For example, Uma described her need to broaden her views:

> I think looking as a math coach, who is looking at the whole picture, K-5. When I was in my own classroom, I focused on my kids and my grade level. Now I consider what can we do for our kids, K-5, and what can we do for those teachers. So, I have a broader perspective and look for ways to make connections: Kindergarten, first, second, third, fourth, and fifth so we can bridge those gaps.

Isabel also described a shift in perspective: "I think about where classroom teachers are and what they are doing and what will work for them. But I also think about where we want to go having a broader goal rather than just what is happening in my classroom today or tomorrow or next month."

BUILDING CONFIDENCE TO APPLY NEW SKILLS

New mathematics coaches need to build confidence in their skills as a leader—skills that allow them to implement their enhanced knowledge base. For example, new coaches have developed, over many years, finely honed skills of managing a group of youngsters or teenagers. Yet, those finely-honed classroom teacher skills may have little applicability when facilitating teacher study groups, vertical grade-band meetings, one-on-one classroom coaching, or large group professional development. With limited skills and experience in these areas, new coaches often lack confidence to do their jobs.

Several coaches talked about a lack of confidence in their new role and with the new knowledge they were building as a result of their required professional development in *Cognitive Coaching* (Costa & Garmston, 1997). For example, Ramona said,

> This coaching thing that we're learning about, the cognitive coaching, is definitely a weakness for me right now. It's been very hard. I think that's across the board when I've talked to other coaches as well, that we talk about being a consultant, and being a coach, and it's really hard when a teacher comes to you and they have two minutes, and they just want the answers, and they're new teachers, not to just give them the answers, because you really want to.

Other coaches spoke about their overall confidence in their new roles. For example, Uma said, "I felt confident as a teacher within my own little domain, but to feel like I could have an impact on other people, I didn't have that confidence. Mary agreed, "It feels so strange because I'm so comfortable working with kids, but not when I'm trying to decide how to influence a teacher. Rebecca also spoke of not having confidence in her new role, "I am just not as much there yet feeling confident in knowing that this is my role. I don't feel like everyone at my school has accepted me in this role yet and that is kind of a surprise."

NEGOTIATING INTERPERSONAL RELATIONSHIPS

New mathematics coaches often find themselves in an undefined role in the school—not a teacher, not an administrator. As such, new mathematics coaches need to learn to re-negotiate interpersonal relationships with classroom teachers, administrators, students, parents, and the community. New mathematics coaches may become aware of certain power structures within a school or district and they may be confused about how their positions fit within these power structures. In addition, mathematics coaches may, for the first time, encounter resistance to their efforts to improve instruction from teachers with whom they have worked for many years.

Ramona described her relationships with teachers she had taught with for a number of years:

> [Our relationship has] been a little different—I think because I know the teachers. In some ways that's a good thing, in some ways that's a bad thing because they view me differently. I've always been a part of their staff, and so when I come in to work with them, I think some of them may feel threatened. I tell them 'we're not evaluators in any way.' I don't know if they really believe that.

Rebecca also described having to negotiate new relationships with teachers she has worked with:

> We have several veteran teachers there who…are our biggest resisters. I have worked in the same hallway with them for years and they don't feel like I have anything that I can share that is new information for them. They are happy for my new role, but they don't see how I can benefit them . . . I have had some very close relationships with them and I see that these are not as close as they used to be.

Isabel described having to build trust with teachers she has not worked with in the past:

> I mean it goes back to—one of the big things is developing trust with teachers, which I'm trying really hard to do. It's just, it's like one of the things I want to do is I want to do a math vertical team, but how do I offer that when I don't want to require anything because I know that by saying you must come to this that it's burning bridges, not building bridges.

Negotiating new relationships, whether with teachers who have been peers in the same school or with teachers in a new school, can be stressful for new coaches and present new emotional challenges for them.

FACING NEW EMOTIONAL CHALLENGES

Classroom teachers who transition into leadership roles like coaching face a range of emotional challenges. As new coaches move from being a peer of their teacher colleagues to being a leader of those colleagues, they enter a murky

area for both the leader and their colleagues. They no longer feel comfortable "venting" to the same colleagues and are unsure about whom to approach for emotional support. New leaders and coaches have concerns about their visibility (i.e., teachers may ask, "What do coaches do all day?"), other's perceptions of their work (i.e., fear of being perceived as a "slacker"), and their reputation as an educator (i.e., distance from classroom teaching). They also encounter fear as they face new challenges, experience disappointment as colleagues resist their efforts, and sadness from losing their teaching positions.

For example, Isabel talked about the emotions she felt as she watched the teachers in her schools get ready for the beginning of the school year:

> I'll tell you when school started and I saw teachers were in their rooms planning and getting ready, it was guilt. I felt a lot of guilt about not having that insane work that needs to be done. And when I look at parent-teacher conferences that are coming up, and I look at report cards and midterms and sometimes I feel like, I just, teachers are asked to do so much. And I feel guilty that I'm not doing that anymore, that I'm not dealing with that.

Uma spoke of facing the emotions of not being in the classroom with students:

> It was tough the first month. I have to say more than anything just because I'm a teacher at heart, and I miss being in the classroom every minute of the day. I mean I'm in the classroom a lot, but I miss that, you know, being with kids, because that's what I really miss. You know, just trying to figure out why they aren't understanding something, trying to figure out a way to support them, and trying to get them to understand it. That was always what I loved: talking with a child that couldn't get it and then what could I do to help them. Just that contact; I miss that.

Carolyn expressed similar sentiments about her classroom:

> I find it really awkward to be in my old classroom. That's the hardest one to go into because I feel like a fish out of water in there...I probably visit that class less than any, for a couple of reasons. It feels a little uncomfortable…When I go in there I just feel kind of guilty, like I left them. Like, "Oh, I left you guys, I'm not in here with you.

While Ben explained how sometimes these emotions were unexpected:

> Some interesting things really made me feel, I don't know, kind of sad. One of them you wouldn't expect was the first time we practiced the fire drill I had no group of kids, I was like lost…what do I do? Just go outside and stand around. That's kind of when it hit me, I don't have my own group of kids that you make into your team, your family.

Other coaches spoke about the emotions they felt in relation to assuming their new positions and learning new skills. For example, Isabel said, "So, when I look at the other math coaches—I'm emotional all of a sudden ... sometimes I feel like I don't know as much as I need to know to do the best job that I can do." Ramona was also feeling some stress about her new job:

> I feel like I do a lot of things, and I don't do any of it well. Whereas, I'm one of those people who likes to, I like things to be a certain way, like I said before I'm very organized, and I have high expectations and I feel like I want things to be this way, but then I try to do everything that people are asking of me, so then I'm too stretched.

SUPPORTING THE TRANSITION FROM EXPERT TEACHER TO INSTRUCTIONAL COACH

West, Hanlon, Tam, and Novelo (2007) argue that teacher leaders rarely receive ample training, support, or direction and are isolated from other teacher leaders. School and district administrators including principals, curriculum coordinators, superintendents, and more experienced mathematics coaches need to address these problems and play a critical role in supporting beginning coaches. Novice coaches face many new challenges as they transition into their new roles as illustrated above. School district personnel need to carefully consider how they design, initiate, and implement support structures for new mathematics coaches. Even though some challenges may be lessened, others challenges (e.g., dealing with resistance and lacking leadership experience) occur for every novice coach. Therefore, school administrators can support beginning coaches by helping them develop strategies through the use of formal and informal support structures.

For example, the coaches with whom we worked consistently identified communication as a critical component of shared leadership and support. As Ilene noted, "My biggest

frustration was not having direction at the building level... as there were no conversations with my administrators except when there was a need. I think I could have been more effective if I would have had more specific direction ...I have worked with my administrators for a long time and I know they trust me to do a good job. I just sometimes felt unsure of what to do and how and when to do it." Ramona wrote, "My principal and I talk several times a week...whenever the need arises ... to keep the lines of communication open." Beyond opportunities for communication, the mathematics coaches specifically suggested that the nature of this communication needed to be structured. Carolyn wrote, "The building principal should work with the coach to set goals for how to best utilize the math coach. These goals should then be communicated to the coach and follow up dates set to discuss the progress." Ramona suggested that the school administrators develop short and long-term goals. She wrote, "Be specific about what you want the coach to do. If you say meet with grade levels each month, what do you have in mind? Work on specific issues? Review curriculum? What is the general goal?" The mathematics coaches also discussed the importance of defining and communicating their roles and responsibilities to school administrators, faculty, and staff. Carolyn wrote, "When the coach's role has not been well defined in the building, then there can be animosity created between the coach and other staff because the coach is seen as not having the same expectations as others."

Based on our interviews and interactions with beginning mathematics coaches, we make the following recommendations for administrators and mathematics leaders:

1. Provide opportunities for coaches to attend professional development focused on leadership and coaching so that coaches have the opportunity to develop new knowledge, skills, and dispositions. Further, it must be recognized that to develop leadership knowledge and skills takes time. For example, some of the coaches we studied attended professional development to discuss cases written by mathematics coaches (Morse, 2009).

2. Provide professional resources for coaches (e.g., books and articles) that focus on teacher leadership and coaching.

3. Provide opportunities for coaches (across a district or region) to meet regularly to identify problems, brainstorm possible solutions, and support one another. The coaches we studied found it helpful to write situations they were facing and role play potential coaching actions for those challenging situations. They also needed the emotional support from other coaches.

4. Protect the coaches' time (as much as possible) for the job they are supposed to do. In studying how the leaders spent their time, we found some coaches devoted a small percentage of their time to the role they were hired to do; instead they participated in activities such as additional playground supervision.

5. Acknowledge and discuss the challenges. Particular attention should be given to facilitate interactions among new coaches so they can develop the new knowledge and skills that are required in their new position.

6. Identify experienced leaders to mentor new coaches. These mentors must be willing and available to work with new coaches. In addition, mentors need to initiate frequent contact with the beginning coaches, sharing resources and engaging in problem-solving discussions.

7. Mutually define the coaches' role and recognize that it will continue to evolve over time.

8. Develop ways to document the coaches' work and the influence that coaches have at the school level. This provides evidence to teachers, administrators, and parents about the critical role that mathematics coaches serve.

9. Engage in discussions about school/district contexts and incorporate new coaches into existing school/district leadership teams.

10. Encourage coaches regularly.

In summary, administrators need to create structures to prepare and support coaches as they transition into new roles. Coaches need to initiate and participate in both formal and informal support structures so that they develop the skills, knowledge, and disposition to effectively lead others. Finally, both administrators and coaches need to address the challenges that coaches will undoubtedly face so that they will be encouraged and energized to lead.

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Principals' Views of Mathematics Teacher Learning

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Ongoing reforms in mathematics education in the U.S. have called for significant changes in instruction. Teachers from kindergarten through high school have been asked to include additional topics in their mathematics lessons (NCTM 1989, 2000, 2006). Furthermore, teachers have been encouraged to use instructional methods that foster meaningful student learning of mathematics concepts and procedures (Kilpatrick, Swafford & Findell, 2001). These demands, however, have been found to be quite challenging for teachers, and in many cases, require learning on the part of the teacher (Cohen, 2004; Fennema & Nelson, 1997).

To address this need for mathematics teacher learning, a variety of professional development programs have been developed. Still, research illustrates it is simply not enough to attend professional development and learn new ways of supporting student learning in one's classroom. The school in which one teaches must embrace such learning, and support the extended efforts needed to implement these issues with material and interpersonal resources (Gamoran et al., 2003; Little, 1993). In particular, school leaders are believed to play a central role in promoting mathematics teacher learning. Yet in contrast to the extensive literature on mathematics teachers' knowledge and practice, relatively little is known about the extent to which principals and other school leaders understand the nature of mathematics teaching today and the current demands for mathematics teacher learning.

In this article, we explore this issue by investigating the views held by a group of urban school principals concerning mathematics teacher learning. We focus our investigation on how the principals interpret particular challenges faced by mathematics teachers and the kinds of support they recommend providing teachers in the area of mathematics instruction. The results of this study advance our theoretical understanding of the relationship between the practices of school leadership and teacher learning. In addition, the study offers practical implications concerning how we might support principals in their efforts to promote mathematics teacher learning at their schools.

School Leadership and Subject Matter Reforms

Over the last decade, there has been increased interest in the role of school leaders in the implementation of educational reforms (Nelson, 1998; Spillane, 2000; 2002). One focus of such research has been on the ways in which administrators enable or constrain reforms that target specific subject matter. Research in this area emphasizes that many district and local leaders entered the field of administration at a time when leadership practices were considered fairly generic across academic subjects. Thus, observing a lesson, whether it was in mathematics, science, or social studies, called for largely the same expertise on the part of the administrator. In contrast, current educational theories highlight the subject-specific nature of student learning, and subsequently the need for administrators to be able to recognize features of instruction that are specific to particular domains.

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Related research examines the ways in which school leaders' interpretations of reform influence their leadership practices. In particular, researchers find that beliefs and knowledge about subject matter influence leaders' approach to reform implementation (Nelson & Sassi, 2000; Stein & D'Amico, 2000). For example, Burch and Spillane (2003) examined the views of elementary school administrators and curriculum coordinators concerning mathematics and literacy. They found that, overall, the leaders perceived mathematics to be a well-defined and highly-structured discipline in which mastery develops through formal training. In line with this perspective, the leaders believed that outside expertise was required in order to help teachers at their schools improve mathematics instruction. In contrast, the same leaders viewed literacy not as an isolated school subject, but rather as a diffuse domain related to multiple disciplines. Along these lines, they emphasized school-based activities and the sharing of pedagogical techniques as the basis for improving literacy instruction. Furthermore, as is the case for teachers, coming to understand the goals of reform is not always a simple matter for administrators. Specifically, Spillane (2000) illustrates that while district leaders may be aware of current mathematics education reform policies, they tend to focus on surface-level features of reform, such as the use of manipulatives and group work, rather than on more substantive aspects such as providing opportunities for student mathematical thinking.

PRINCIPALS' PROFESSIONAL VISION

In this research, we examine leadership practice by focusing on one component of leadership expertise that we call *principals' professional vision*. Professional vision is a construct introduced by Goodwin (1994) to describe the ways in which members of a professional discipline attend to the phenomena that is the focus of their work. For example, an archeologist recognizes variations in sands and stone, and a meteorologist can detect patterns in clouds and weather.

In prior work (Sherin, 2001, 2007) we characterized teachers' professional vision as the way in which teachers pay attention to classroom interactions. Furthermore, we identified two central components of teachers' professional vision: (a) how teachers identify significant aspects of classroom interactions, and (b) how teachers interpret what they notice as significant. Thus, teachers' professional vision is concerned both with what teachers notice and how they make sense of these events. Here we extend our investigation of professional vision to principals and in particular, to *principals' professional vision of mathematics teacher learning* (PVMTL). In other words, we are interested in what principals identify as significant issues related to mathematics teacher learning as well as how they make sense of these issues.

This focus on how principals notice and interpret mathematics teacher learning is not entirely new. For instance, Stein and Nelson (2003) discuss the notion of *leadership content knowledge* in the context of mathematics. In doing so, they emphasize the importance of school leaders having an understanding of how teachers learn to teach mathematics as well as an understanding of how to promote such learning among teachers. In other research, Nelson and Sassi (2000) investigate the expertise needed to supervise mathematics teachers. Drawing on the idea of practical judgment (Fenstermacher & Richardson, 1993), Nelson and Sassi argue that administrators need to know what to pay attention to and how to make sense of what they see happening in mathematics classrooms today. Here, we build on such work, but look specifically at how leaders identify and interpret situations that require mathematics teacher learning.

To be clear, by focusing on the professional vision of *principals* in particular, we recognize that we are taking a somewhat limited view of school leadership. Current models of leadership practice emphasize that authority is no longer considered to reside in a single person such as the principal. Instead, leadership in schools is typically distributed among formal and informal leaders (Spillane, 2006). Nevertheless, we believe that our attention to principals in this study is a valuable step towards understanding more broadly how school leaders identify and interpret the need for mathematics teacher learning.

SUPPORTING MATHEMATICS TEACHER LEARNING

Exploring principals' views of mathematics teacher learning requires familiarity with current research on the topic. Therefore, we now provide a brief overview of some key issues related to mathematics teacher learning. First, teaching mathematics effectively today calls for teachers to have an in-depth and well-connected understanding of the mathematics they teach (Ball & Cohen, 1999). Yet in many cases, teachers' knowledge of mathematics is lacking in this regard. For example, as learners themselves, teachers may have experienced multiplication as a set of facts to be memorized

and algorithms to be practiced. In contrast, in working with students today, teachers are expected to explore the meaning of multiplication, and to be able to illustrate multiplicative relationships with visual models and manipulatives. This focus on conceptual understanding in particular has been found to challenge many teachers' own understandings of mathematics (Ma, 1999). Moreover, even when provided with reform-based curricula or other new instructional strategies, teachers' limited knowledge of mathematics may constrain their successful use of the materials (Sherin, 2002).

Second, teachers are expected to pay close attention to the ideas that students raise about mathematics during instruction (e.g., Lampert, 2001). Rather than focus solely on whether a students' answer is correct or not, teachers are encouraged to unpack students' methods and to probe students' reasoning. Such diagnosis of student thinking requires knowledge not only of mathematics per se, but also of the ways that students' understand and learn mathematics (Ball, Thames, & Phelps, 2009). Furthermore, for many teachers, focusing on students' thinking requires a shift in perspective—toward the realization that students can in fact have interesting mathematics ideas, ideas that can potentially move a lesson forward (Franke, Carpenter, Levi, & Fenemma, 1991).

In light of these issues, a number of professional development programs have been created to support mathematics teachers in their own learning. To be productive, such programs must start from the premise that learning to align one's practices with the goals of reform takes time and involves in-depth reflection on the nature of mathematics and mathematics teaching. In particular, research has shown that effective professional development programs often include several common features (Ball & Cohen, 1999; Cohen, 2004; Wilson & Berne, 1999). First, they actively engage teachers in in-depth explorations of mathematics and encourage teachers to share their methods and solutions with peers. Second, they offer teachers the opportunity to analyze student mathematical thinking through analysis of classroom videotape or completed student work. Third, they promote teacher inquiry into and reflection on their own classroom practices.

In sum, the need for teacher learning in the area of mathematics has been clearly documented, as have attempts to support such learning through professional development. Yet the extent to which principals understand these issues is less well known.

Methods

RESEARCH DESIGN

This research takes place in the context of a larger study on the problem-solving practices of urban school leaders. Thirty-five principals from a large urban school district in the Midwestern U.S. volunteered to participate. Two-thirds of the principals were female and one-third were male. Furthermore, approximately one-third of the principals classified themselves as belonging to each of the following ethnic groups: African-American, Hispanic, and White. This breakdown aligns well with the school district as a whole, in which approximately two-thirds of principals identify themselves as belonging to a minority group. The principals averaged 54 years of age, and had, on average, 12 years of experience as classroom teachers and 11 years of experience as principals at their current schools.

Almost all of the principals worked at elementary schools that housed students from grades K – 8, while a few of the principals worked at middle schools. Two-thirds of the schools represented in the study served predominately African-American or Hispanic student populations. In addition, in all but a few schools, 67% or more of the students received free or reduced lunch.

Data for this study come from interviews conducted individually with each principal at his or her school site. In the interview, each principal was asked to respond to six scenarios—two focusing on mathematics teaching, two focusing on literacy instruction, and two exploring more general issues of school leadership. All six scenarios were designed to represent open-ended problems concerning school leadership and involved asking the principal how he or she would respond given a particular situation. The interviews lasted on average one hour. All interviews were audiotaped and transcribed.

For the purposes of this study, we focused exclusively on the two mathematics scenarios. The first of these, which we call Scenario A, described a situation in which the principal is reviewing lesson plans and finds that an otherwise proficient teacher is using a "drill and kill" style of mathematics instruction. In contrast, the philosophy of the school advocates a standards-based approach to support student learning. The question posed in the interview asks how the principal would "bring this teacher on board."

In the second scenario, Scenario B, the principal is told that a number of teachers at his or her school admit to not being comfortable teaching mathematics. In addition, students' test scores illustrate a weakness in the area of mathematics. The principal is then asked, "How will you address this situation?"

DATA ANALYSIS

Analysis of the data proceeded through three main phases. The goal of the first phase was to identify key dimensions along which the principals' PVMTL was exhibited in the interviews. That is, we wanted to establish categories related to what the principals' recognized as salient in the scenarios as well how they interpreted these salient features. To do this, we used a method of open coding (Emerson, Fretz, & Shaw, 1995) in which a subset of 10 interviews were reviewed by two researchers and evidence for potential coding categories was noted. This process was repeated until a stable set of coding categories was identified. As a result, six main coding categories were established: (a) the extent to which the principals focused on the subject matter of mathematics, (b) whether principals related the scenarios to situations experienced at their own schools, (c) steps that principals outlined in describing how they would respond to the teacher(s), (d) whether they offered reasons for the teachers' actions and (e) whether rationales were provided when recommending specific professional development opportunities.

The second phase of analysis involved systematically coding all 35 interviews along each of the specified dimensions. One researcher coded the entire data set, while a second researcher coded both scenarios from 12 principals. Inter-rater reliability ranged from 83% to 100% across all dimensions. Disagreements were resolved through discussion. We note that one participant did not address Scenario A or B in the interview, despite being presented with both scenarios. Two additional participants did not address Scenario A, and one more did not address Scenario B. These responses were removed from the data set and were not coded.

In the third and final phase of analysis, we examined the coded data in order to identify any patterns across all of the principals' PVMTL. In doing so, we identified some patterns that held across both scenarios presented to the principals, as well as patterns that were more specific to one scenario or the other.

Results

Our analysis of the interviews revealed several interesting features of the principals' PVMTL. In particular, three issues related to teacher learning were noticed by the majority of principals: (a) the realistic nature of the situations portrayed, (b) the role of the principal in affecting change in teachers' practices, and (c) the potential of professional development to support teacher learning. Despite these similarities in what was noticed, the principals' interpretations of these issues differed to varying degrees. Furthermore, we also noted one feature of the scenarios that most principals did not attend to in their responses—the fact that the scenarios presented were specific to mathematics. In what follows, we discuss these findings in greater detail. For the reader's reference, the results of coding of each principal's responses can be found in Appendix A.

RECOGNIZING A FAMILIAR SITUATION

Principals' responses indicated that, for the most part, they identified the two scenarios as familiar circumstances that they could realistically envision taking place. Comments such as "this is a situation that lots of schools are faced with" were not uncommon. In addition, the principals often referred to similar issues at their own schools; 73% of the principals mentioned the relevance of the scenarios to what was happening at their schools. Some principals explicitly noted the familiarity of the situation, making comments such as "that is a true scenario here" or "I encountered something similar to that." Other principals described the approaches they were currently using to address comparable situations. For example, one principal explained that "My 4th grade teachers just got back from the state [NCTM] conference," while another commented that "Locally here, we're involved with the Teachers' Academy for Math and Science. Our teachers go to classes there."

Additional evidence that the principals recognized the familiarity of these situations comes from the fact that the majority of principals (77%) were quite comfortable offering explanations for why the situations might have occurred. Principals suggested that the teachers might have been uncomfortable using their assigned curriculum materials, might have needed to improve their proficiency or confidence in math, or (for Scenario A) might have believed that their current teaching methods were effective. In sum, situations in which a teacher needed to improve his or her teaching in a particular area appeared fairly standard to this group of principals.

We note that 25% of the principals did express some skepticism about Scenario A.[1] In these cases, they tended to buy into the concern that a teacher might be using less-than-ideal teaching methods. Their concerns related more to the "technical" aspects of the question. For example, a few principals said that teaching issues were more likely to arise during classroom observations than through reading lesson plans. Other principals commented that they did not believe in imposing an all-school philosophy about how to teach. "It's difficult for me to put myself into this position that there's one philosophy, there's only one way of doing it."

RECOGNIZING A NEED FOR ACTION ON THE PART OF THE PRINCIPAL

In addition to recognizing the scenarios as representing familiar situations, the principals also recognized that they called for action on the part of the principal. Thus, rather than letting things progress in their current course, the principals' responses indicated that they believed they had an active role to play in improving the teachers' instruction in mathematics. Their comments also suggested that, rather than place the responsibility for change entirely on the part of the teachers, other school personnel, or professional development providers, they as principals expected to be directly involved. For example in response to Scenario A one principal explained, "What I would do, well first of all, the teacher and I would have a conversation." And another commented, "First and foremost I must observe her…I have to see for myself." Similarly, after hearing Scenario B, a principal stated "So now my job is to, how do I make teachers comfortable teaching something that they feel a little… insecure with." Rarely did a principal imply that change was primarily up to the teachers stating simply, "Well, they have to go to professional development."

Not only was the need to take action common across the principals' responses, there was also a great deal of commonality in the specific steps that the principals stated they would take. In fact, for both Scenarios A and B, the principals seemed to call on fairly well established routines to respond.

Scenario A Routines

In responding to Scenario A concerning the teacher who uses "drill and kill," principals routinely described three types of actions; principals explained that they would (a) *get additional information* about the situation, (b) explicitly *tell* the teacher what to do differently, and (c) *provide resources* that might help the teacher improve. In all, 60% of the principals referred to all three of these actions in their response; 81% referred to at least two.

Principals seemed to recognize that merely viewing a lesson plan does not provide adequate information about what is happening in the classroom. Overall, 88% of the principals said that they would want to *get additional information* about the situation in Scenario A. Many principals wanted to perform a sort of "triangulation" of the data by conducting classroom observations, looking at student test data, or talking with adults in the school who might be more familiar with the situation. Principals also expressed an interest in getting additional information because they wanted to know more about why the teacher was relying on "drill and kill" methods. It was common for principals to express an interest in "talk[ing] with the teacher to find out her reasoning why." As one principal explained:

> I guess the first thing I'd want to know is does the teacher have the necessary materials to use? Does the teacher know how and feel comfortable using [the materials]? Or is it just a philosophical thing?

Here the principal is concerned both with the materials available to the teacher, and the teacher's perception of whether or not she knows how to use the materials. The principals also described steps that extended beyond gathering information and were intended to instigate change. In all, 75% of the principals said that they would explicitly *tell* the teacher that she needed to adopt new teaching methods. For example, one principal emphasized that she would "explain that this is not acceptable at our school." In contrast, a few principals recognized a need for change, but did not feel that it would be effective to directly tell the teacher what to do:

> It would be something where you wanted the teacher to actually realize she had to change, not with someone dictating to her. …You want them to be, you know to help, a self discovery that maybe there's a different way.

To be clear, a number of principals were explicit that they would tell teachers their expectations in a way they

[1] None of the principals expressed concern that Scenario B was unrealistic.

believed was supportive. For example, one principal said that he "would not come down on the teacher as 'You are wrong,' but [as] 'This is what my expectations are.'" This focus on telling suggests to us that the principals may not be aware of the kind of learning typically required in order to shift one's instruction in line with the goals of reform. Mathematics education reform requires more than a simple change in instructional methods; it requires in-depth knowledge to support the use of such materials as intended. It seems possible that the focus on telling was intended only as a motivational factor, and not as the catalyst for change. However, this distinction was not made by the principals in their comments.

A third action that principals described was to *provide resources* that might help the teacher(s) improve. In using the term "resources" here, we draw on Gamoran and Anderson's (2003) notion that "material, human, and social resources [can] each contribute to schools'…capacity to support teacher change," (p.28). Principals proposed the use of such resources in 78% of their responses to Scenario A. Frequently mentioned forms of support include the opportunity to observe other teachers' classrooms, coaching and mentoring partnerships with teachers and administrators at the school, school-based staff development programs, the selection of new curricula or additional materials, externally facilitated professional development training, and formal coursework in mathematics education.

Scenario B Routines

These three categories of actions can also be discerned in principals' responses to Scenario B but to different degrees (Table 1). (Recall that Scenario B concerned a group of teachers who report that they were not comfortable teaching mathematics.) *Providing resources* was the most common response to Scenario B; all but one principal (97%) included at least one resource as part of his or her plan of action. Principals suggested a broad range of resources to help the teacher in Scenario A, from internally provided, informal support (e.g., peer observation), to more structured, externally facilitated professional development programs. In contrast, the resources suggested to help teachers in Scenario B were much more likely to be brought in from outside the school. For example, principals frequently mentioned formal professional development programs run by curriculum publishers or university instructors. It is possible the principals felt that, because an entire group of teachers needed support in Scenario B, there might not be sufficient resources to turn to within the school. In contrast, in Scenario A, where only a single teacher is described as having difficulty, there would likely have been other teachers within the school who were skilled at using reform-based strategies to support student learning.

Somewhat fewer principals (42%) expressed a desire to *get additional information* as part of their response to Scenario B as compared to Scenario A. We believe that this difference may reflect the fact that more sources of data were included as part of Scenario B (teachers' comfort and student test scores, versus only teachers' lesson plans in Scenario A). Thus, principals may have viewed the gathering of information as a key action, but believed that this task had already been completed in Scenario B.

The most noteworthy difference in principals' responses to the two scenarios is that, in Scenario B, they were much less likely to explicitly *tell* teachers their expectations for a change in teaching practices (24% for Scenario B versus 75% for Scenario A). We hypothesize two potential reasons for this difference. First, the teachers in Scenario B were clearly aware of the need to make a change in their teaching practices, whereas the teacher in Scenario A may or may not have seen a deficit. As one principal stated, "I try to separate those that are unwilling from those that are unable, because there is a major difference in those two

Table 1

STATED PRINCIPAL ACTIONS IN RESPONSE TO THE SCENARIOS			
	Description	**In Response to Scenario A**	**In Response to Scenario B**
Get Additional Information	Gather further data about problem	28/32 (88%)	14/33 (42%)
Tell	Explicitly state expectations to teacher(s)	24/32 (75%)	8/33 (24%)
Provide Resources	Suggest material and/or human supports for teacher(s)	25/32 (78%)	32/33 (97%)

types of people within a school setting." Thus, there may be little need for principals to tell the teachers in Scenario B that they expect a change, when they have already come to the principal asking for help. In addition, it is possible that principals expect *telling* to be more useful when dealing with a single aspect of one teacher's practice than when trying to effect broader change in a group of teachers' approaches.

RECOGNIZING THE ROLE OF PROFESSIONAL DEVELOPMENT IN TEACHER LEARNING

As stated above, one action principals frequently mentioned they would take is to provide opportunities for teachers to participate in professional development. Specifically, the majority of principals recognized that when considering issues of teacher learning, professional development is relevant. In fact, of the three actions described in the previous section, *providing resources* was the most commonly discussed across the two scenarios (in 88% of the total number of responses).

In the previous section, we discussed the range of resources suggested in response to Scenarios A and B. Specifically, principals described support from within as well as outside of their schools, they discussed formal workshops and informal gatherings, and they described resources that drew on both material and human expertise. In doing so, it was quite common for principals to suggest multiple resources that they would offer to teachers; 82% of the time in which resources were discussed, multiple resources were proposed. Yet, principals typically presented these resources simply as a list of possibilities without connecting specific ideas to the learning needed for teachers. For example, in response to Scenario A , one principal said he would ask the teacher:

> How can I help you? …What kind of services? Do you need additional training? Do you need some peer mentoring? Do you need me to come in and do some modeling for you?

In another case a principal stated:

> We can have some of our other teachers do presentations to some of them. If we have funds we can bring a specialist in to talk to them. Whatever textbook series we're using, they have a specialist who will come in. …Sometimes there's somebody at another school, neighboring school, who's really strong at math.

Note that in both of these examples, a number of supports were mentioned, but little detail was given concerning what the resources would involve, for example how much time teachers would participate and whether a program would occur only once or take place in an ongoing manner. Lack of attention to such details was quite common across the responses. In addition, principals typically provided little information concerning the specific content that would be covered in a class or workshop. While principals frequently suggested sending teachers to a workshop, for instance, they did so without elaborating what the content or goals of that workshop might be.

In addition to a lack of detail, principals tended to present multiple resources merely as a collection of possibilities, rather than as a deliberate sequence of actions. This is the case in both examples above. In contrast, in only 11% of responses did principals describe a progression of action, such as "I'd try to have her do some peer observations [first] and then [I'd] send in someone to help coach her along until she feels comfortable." Finally, we want to point out that in discussing different possible resources, the principals did not always provide an explanation as to why a particular resource might be useful given the context of the scenarios. In all, principals offered a rationale for a particular professional development opportunity in only 31% of the total responses (Table 2), and in most of these cases, the rationales reflect little of the complexity of teacher learning required. For example, in response to scenario B, the following principal suggested that he bring in a specialist from the textbook series. He explained,

Table 2

FEATURES OF "PROVIDE RESOURCES" ROUTINE		
	In Response to Scenario A	**In Response to Scenario B**
Multiple resources suggested	21/32 (66%)	26/33 (79%)
Sequence of resources suggested	5/32 (16%)	2/33 (6%)
Rationale for resource suggested	11/32 (34%)	9/33 (27%)

Table 3

SALIENCE OF MATHEMATICS IN PRINCIPALS' RESPONSES		
	In Response to Scenario A	**In Response to Scenario B**
Response does not mention mathematics	21/32 (66%)	15/33 (45%)
Response related superficially to mathematics	7/32 (22%)	12/33 (36%)
Substance of mathematics integral to response	4/32 (13%)	6/33 (18%)

"[The text] might have 400 pages but the kids never get through page 300 so that last 100 pages of math [the teachers] never learn." This principle seemed to recommend a review of mathematics units that most teachers at his school do not teach, rather than, as reformers would advocate, an in-depth investigation of the mathematics the teachers do teach.

ABSENCE OF A RECOGNITION OF MATHEMATICS

While what principals noticed in these scenarios is an important part of their PVMTL, it is also worth noting which aspects of the situations were not salient. In particular, many of the principals did not refer to mathematics at all (see Table 3). In other words, they were not attuned to recognizing these scenarios as subject-specific. One principal even explicitly emphasized the general nature of her response by saying, "There are two things that I believe will be effective in helping teachers succeed no matter what the subject matter is."

It is also worth noting that, even at those times when principals referred to something math-specific, they did not always focus on substantive issues in the teaching of mathematics today. For example, consider the following response to Scenario A:

> I might even ask one of the other teachers…to let her come in and observe how she sets up her cooperative learning groups that are working with the manipulatives and let her see that it's really a very controllable kind of thing to do. …I mean, I have this teacher in mind, as you ask me this question, who is a marvelous teacher but she is from the old school and she does think that kids should be in their desks and they shouldn't be moving around and they certainly shouldn't be playing with manipulatives.

In this response, the principal focused on the need for the teacher to learn how to use manipulatives in the classroom. The use of manipulatives in and of itself, however, does not constitute standards-based instruction. Teachers may simply add manipulatives in support of their traditional instructional approaches rather than use them to promote sense-making on the part of students (e.g. Cohen, 1990). Here then, it seems as if the principal viewed the solution as one of learning new forms of classroom management, rather than of developing new understandings of mathematics or of how manipulatives support student learning. This sort of response was common, even among those principals who displayed an understanding that the domain of mathematics presents its own unique challenges to teachers.

There were a few principals, however, who recognized that in order to improve mathematics instruction, teachers needed to learn not just new ways to manage their classrooms, but new ways of thinking about the subject itself. One principal stated that "Part of the problem, I think, is the fact that many elementary teachers have an elementary certificate…and they're not specialists. The new math that's in place today demands that teachers are literate in math." The implication here is that to be "literate in mathematics" today requires knowledge of mathematics that extends beyond what many elementary school teaches are prepared for. Other principals commented specifically on the new forms of conceptual understanding that students must achieve:

> Most of our kids are weak in making estimation and judgments and doing graphs and percentages; problem solving….They can add, they can subtract, they can count; they do really well on those common things like that, computations. But when it comes to reading a graph, doing estimation, they have a problem with that.

Along the same lines, another principal explained:

> So it's not just all about computation. And basically that's, I'm sure, what you're talking about when you say 'drill and kill.' It's computation, computation, or doing the same thing over and over and over again until you

> get the way I have taught it to you. Because schools really have changed quite a bit and now what you look for are students who are able to utilize the information, methodologies, techniques in more than one area. So, you're looking at being able to cross reference information, and build on your experiences.

These principals emphasized the kinds of mathematics knowledge among students that teachers will need to be able to support. In this way, the principals' PVMTL not only incorporated an understanding of the subject-specific nature of mathematics teaching, it incorporated familiarity with substantive issues related to ongoing reforms in mathematics.

Discussion and Conclusion

In this article, we examined how a group of urban principals view issues related to mathematics teacher learning. In particular we investigated principals' responses to two scenarios that called for improvements in mathematics teachers' instruction. Our study is framed in terms of principals' *professional vision of mathematics teacher learning*. Thus, we were interested in characterizing what the principals noted as key issues surrounding the need for mathematics teacher learning as well as how they made sense of these issues.

First, in terms of what the principals noticed as salient in the two scenarios, there was a great deal of commonality. Specifically, the majority of principals in our sample considered the issue of teacher learning to be quite familiar, and they reported experiencing similar situations at their own schools. At the same time however, the principals did not seem to recognize the complexity of what teachers needed to learn and of the process that would be required to support such learning. In particular, the principals did not usually view the subject area of mathematics as relevant in considering how to address the two scenarios. Most principals did not mention issues related to the particular teaching of mathematics in their responses, or if they did, mathematics was not treated in a substantive context. In only 15% of the responses did the principals discuss specific demands of mathematics teaching and learning and the relationship between such demands and the given scenarios.

This lack of attention to mathematics on the part of the principals is of concern, particularly in light of current research which finds that teacher learning is a decidedly subject specific matter (e.g., Ball & Cohen, 1999). If principals continue to view teacher learning as a generic issue, they may not promote instructional improvements of the sort envisioned by current educational reforms. Furthermore, without an understanding of the complexity of the mathematics learning that is needed, principals are unlikely to recognize and support the difficult process that most teachers engage in as they work to shift their practices in the direction of reform. To be clear, we are not suggesting that principals must be experts in all subject areas—able to diagnose specific teaching difficulties in light of domain-specific issues. Rather, our claim is that principals need to be aware of the fact that supporting teacher learning calls for attention to subject-specific concerns and is a complex and demanding process for teachers.

Second, in considering how the principals made sense of what they understood to be key features of the scenarios, our results highlight that the principals generally relied on established routines to respond. For example, almost two-thirds of the principals explained that, in response to Scenario A, they expected to *get additional information*, *tell* the teacher to change her instruction, and *provide resources* to support the teacher's learning.

Prior research cites the importance of routines in expert performance (e.g., Berliner, 1994). Establishing routines is thought to help experts manage the cognitive load of complex tasks and efficiently direct a range of activities. Similarly, we recognize the potential benefits for principals of drawing on familiar actions to respond to problematic events that arise. At the same time, however, we note that there are limitations to the use of routines. Precisely because they are familiar, people may not question their effectiveness (Spillane, 2006). In this study, for example, all but one principal expected to engage teachers in professional development. Yet most principals failed to mention a critical step in this process—considering why or how certain programs might support teacher(s) given the particulars of each scenario. For instance, what might be the advantages, for the teacher in Scenario A, of observing another teacher at the school versus attending a workshop on the assigned curriculum versus co-teaching a series of lessons with a district mathematics specialist? At issue here are both the affordances of particular professional development programs as well as the needs of the specific teachers involved.

Recall that many principals (77%) hypothesized reasons underlying the problems presented in each scenario. It seems possible that encouraging principals to connect these reasons to the goals of various professional development programs could be a productive way to help principals think more carefully about those programs they make available to teachers. In doing so, however, principals must also examine the extent to which the reasons they propose reflect the substantive challenges that teachers face in implementing the goals of mathematics reform.

Furthermore, 64% of the principals stated that they wanted to *get additional information* by talking with teachers, observing instruction, investigating student work, and more. Despite these claims, few principals explained how they would then use this information in order mediate the given scenario. Several researchers explain that collecting data about current school activities is an important component of school leadership (e.g., Nelson & Sassi, 2005; Spillane, 2006) In line with this idea, the principals in our sample seemed to recognize the value of gathering information about situations they faced. Yet until they learn to apply this information to the situation at hand, the principals are not taking full advantage of this routine. Moreover, in the case of the scenarios we investigate here, the information principals proposed to collect may be precisely the information they need—about the teacher(s) and about the specific difficulty faced—in order to make an informed decision about the kinds of professional development opportunities to pursue.

The lens of professional vision offers a unique approach for studying principals' views of teacher learning. In particular, this construct highlights the need to understand how leaders interpret situations involving teacher learning and what they identify as significant in such situations. Moving forward it will be important to extend this study to other contexts. In particular, rather than relying on principals' self reports, it will be valuable to investigate principals' actions in practice, in the context of their own school sites. Such data would allow us to examine the robustness of the results we report here, and the application of principals' professional vision to situations at their own schools.

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APPENDIX:
Detailed Coding of Principal Responses

	SCENARIO A										SCENARIO B									
					Stated Routines for Addressing Scenario			Features of "Provide Resources" Routine							Stated Routines for Addressing Scenario			Features of "Provide Resources" Routine		
Principal	Questions Validity of Scenario	Offers Reasons for Scenario	Relates to Own School	Role of Mathematics	Provide Resources	Tell	Provide Resources	Multiple Resources	Rationale Provided	Sequence of Resources	Questions Validity of Scenario	Offers Reasons for Scenario	Relates to Own School	Role of Mathematics	Provide Resources	Tell	Provide Resources	Multiple Resources	Rationale Provided	Sequence of Resources
1				Absent	X	X	X	X				X	X	Substantive	X		X	X		
2												X	X	Substantive	X	X	X	X		
3				Absent	X	X	X	X				X	X	Absent			X			
4												X	X	Superficial	X	X	X	X	X	
5		X		Superficial	X	X	X					X		Absent	X		X	X		
6		X		Superficial	X	X	X		X					Absent			X	X		
7	X	X		Substantive		X						X	X	Superficial			X	X		
8		X	X	Substantive	X	X	X	X		X		X		Absent		X	X	X		
9		X		Absent	X	X								Absent			X	X		
10		X	X	Absent	X	X	X	X				X	X	Superficial		X	X	X		
11		X	X	Superficial	X	X	X	X				X		Absent	X		X	X		
12		X	X	Absent	X							X		Absent	X		X	X	X	
13				Absent			X	X		X		X		Absent			X	X	X	X
14	X	X	X	Absent	X	X							X	Absent			X	X		
15			X	Absent		X	X	X					X	Absent			X			
16	X	X		Substantive	X	X	X	X	X			X	X	Substantive		X	X			
17		X	X	Superficial	X	X	X	X	X			X	X	Superficial	X		X	X		
18		X		Absent	X		X	X	X	X		X		Absent			X	X	X	X
19		X	X	Absent	X	X	X	X	X				X	Absent	X					
20		X	X	Superficial	X	X	X	X	X	X				Superficial			X	X		
21		X		Absent	X	X	X	X				X	X	Superficial	X		X	X	X	
22	X	X		Absent	X		X						X	Superficial			X	X		
23		X	X	Absent	X	X	X	X	X	X		X		Superficial	X		X	X	X	
24				Absent	X	X	X	X				X		Superficial			X	X		
25		X		Absent	X							X	X	Substantive	X		X	X	X	
26	X	X		Absent	X		X	X				X		Absent	X	X	X			
27	X			Absent	X							X		Absent			X	X		
28		X	X	Absent	X	X	X	X				X	X	Superficial	X		X	X		
29		X	X	Superficial	X		X	X	X				X	Superficial			X			
30		X	X	Substantive	X		X	X	X			X	X	Substantive	X	X	X	X		
31	X	X	X	Superficial	X	X	X	X	X											
32		X		Absent	X	X	X		X			X	X	Substantive			X	X	X	
33				Absent		X						X		Absent		X	X	X		
34	X	X	X	Absent	X		X	X				X	X	Superficial			X		X	

Note: Empty cells indicate that the principals did not include this information in their responses. Shaded cells indicate that principals did not respond to the given prompt in the interview.

A District Mathematics Leadership Team: Deepening Collective Focus

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How can a school district work systemically to create a strong mathematics program focused on helping students learn mathematics that makes sense and will be useful to them in their lives?

This is a question often researched by many leaders in the field (Fullan, 2005, Hargreaves, 2006, Elmore, 2005, Senge, 2006) and asked recently by a dedicated group of mathematics leaders fundamentally committed to the improvement of mathematics teaching and learning in a New Mexico school district.

This school district was facing numerous challenges, including the fifth superintendent in five years, newly adopted K-8 standards-based curriculum materials, and a history of implementation of past mathematics initiatives that was described as "fragmented" and "lacking focus." When this diverse group of stakeholders congregated to create and structure a five-year district mathematics plan, it became clear that "lifting every child to powerful mathematics learning" was a responsibility that required a collective focus that included many voices and perspectives so a coherent plan could be created.

We tell the story of how a school district in the desert southwest worked together as a District Mathematics Leadership Team (DMLT) to create a focus and direction for mathematics learning. Specifically, we describe how the group worked systemically to create a shared vision, articulated this vision in a five-year mathematics plan, and thoughtfully considered what it would take to implement the plan, all the while maintaining itself as a community of learners that was able to successfully work together to achieve these goals. We also share important learning from the first year of this effort, identify potential benefits for continuing the DMLT work in this district, and consider what might be gained by initiating this work in other districts around the state.

What is and Why Have a District Mathematics Leadership Team (DMLT)?

The District Mathematics Leadership Team (DMLT) was a group that met regularly to guide and focus learning for mathematics improvement and sustainable change in the school district. The DMLT included individuals from all levels of the school district as well as the local community —district leaders, principals, teachers, school board members, university mathematicians and educators, a business person, parents, and a state representative—all agreeing to collaboratively embark on a journey together to strengthen mathematics teaching and learning in the district.

The National Council of Supervisors of Mathematics (NCSM, 2008, p. 3) believes that communities of adult learners are the building blocks needed to establish a new foundation in America's schools. Typically, creating opportunities for educators and community members to learn together through thoughtful, focused conversations is difficult in the fast pace life of our daily lives. This meant that in order to be successful our work together required a purposeful structure through which members of the team could think, plan action, and learn together.

Cathy Kinzer and Janice Bradley are math educators supporting professional learning through Mathematically Connected Communities, a statewide mathematics partnership.

With these goals in mind, the DMLT engaged school, district, and community leaders in a *working systemically process* (SEDL, 2005) to develop a shared vision, create a five-year math plan, and articulate what it would take to implement this plan successfully—all the while looking toward the horizon of sustainability. What follows is how this process was put into place and what the DMLT was able to accomplish.

How Did the DMLT Get Started in the School District?

Creating a five-year mathematics plan for a district is a complex task. A small group of math educators, a professional development specialist, and a district curriculum specialist met to develop the math plan but soon realized there was a need for input from other stakeholders from the educational system and the business community. The idea for a DMLT was put on the table for discussion, with all members of the small group recognizing the benefits of collaboration and the sharing of ideas, and the director of instruction took the next steps to create and formalize this larger team.

The following four specific actions took place prior to the inaugural DMLT meeting:

Action 1: The initial small group identified who it thought should be invited to join the larger DMLT. Participants were suggested based on their roles in the school district and the community, their willingness to spend time learning in collaboration, and their openness to diverse perspectives. Because it was important to create a microcosm of the educational system and the local community, teachers and administrators from the elementary, middle, and high school levels were suggested as well as school board members, parents, business representatives, a state legislator, and university math educators and mathematicians.

Action 2: The Director of Curriculum and Instruction and university partners met with the Superintendent and Assistant Superintendent to discuss the formation of the DMLT and its role improving mathematics teaching and learning in the district. This was important because it allowed top-level administration to be involved in creating the DMLT and establishing its purpose. The Superintendent was asked to attend the first DMLT meeting and welcome the DMLT participants.

FIGURE 1

October 29

Dear Member of the Public Schools Community,

The beginning of the school year has been exciting and renewing. We strive to provide a quality education for all students in our district. In our continued commitment to provide students with skills necessary to be better prepared for college, work, or the military we constantly review what those skills may be.

How many times have you heard someone say, "I wasn't good at math"? It is almost like a badge of honor for someone to express this. Mathematical literacy is of significant importance to everyone. To be literate in mathematics means that one possesses procedural and computational skills as well as a conceptual understanding of mathematical concepts.

I am pleased to announce that our school system is creating a Math Leadership Team for the purpose of establishing a vision and goals for sustainable and effective mathematics achievement for the district and its students. You have been selected as someone who could make significant contributions to our Math Leadership Team.

I would like to invite you to our first meeting . . .

Sincerely,

Superintendent of Schools

Action 3: The Director of Curriculum and Instruction drafted an invitation letter to join the DMLT that was signed by the Superintendent (Figure 1). The contents of the letter included the following statement of purpose: "This district is creating a District Mathematics Leadership Team for the purpose of establishing a district-wide vision and action plan for sustainable and effective mathematics teaching and learning for the district and its students."

Action 4: The date, time, and location for the initial DMLT meeting was decided and the Director of Curriculum and Instruction sent an invitation to participate in the DMLT to the 25 participants nominated to participate. In the fall of 2007, the group met together for the first time for three hours. The group continued to meet monthly for three hours.

How Did the DMLT Create a Collaborative Culture for Learning?

Collaborative cultures for learning do not happen spontaneously. Fullan (2001) characterizes the need for leaders to "support informed judgment" developed "through cultures of interaction inside and outside the school." This requires creating shared norms and values, enacting purposeful reflective dialogue, and maintaining a collective focus on student learning. The DMLT chose to work together to build a culture of learning through an inquiry process that focused collaboratively on issues of relevance.

Several factors contributed to the development of a culture of learning. These included creating norms for collaboration, using inquiry agendas, facilitating focused learning conversations, and using reflective feedback to inform the explorations of subsequent DMLT work. Each of these factors are described more fully below.

Creating norms for collaboration helped maintain a focus on tasks that needed to be addressed during the meeting times. At the first meeting of the DMLT there was a discussion of how the group wanted to work together. Seven norms of collaboration developed by Garmston and Wellman (1999) were presented to them and DMLT members were asked to select three that could be embraced by the group. The DMLT chose *presuming positive intentions, paying attention to self and others*, and *pursuing a balance between advocacy and inquiry*. These norms were used at each meeting to support the collaboration needed to be successful as a DMLT.

Inquiry agendas were used to promote analysis and exploration. Frequently, agendas are a list of topics to be discussed. Less frequently, agendas are questions with unknown answers. The agendas for the DMLT team meetings included questions for inquiry and exploration that needed thoughtful consideration and a collective focus (Figure 2). All of these questions were essential to the development of a shared vision of mathematics teaching and learning and the creation of a viable mathematics plan for the district.

Facilitation of DMLT meetings was planned, intentional, and strategic. An outside facilitator who would be able to guide how the DMLT worked together was identified and brought into the group. This facilitator's role was to keep the focus of the conversations on exploring the inquiry questions while also creating a safe environment for sharing different points of view and helping the group adhere to its norms for collaboration. This facilitator, being an "outside" person, could also ask and help the group process the harder questions that an "inside" facilitator might have found threatening. This seemed to help the DMLT dig more deeply into the question of a vision for mathematics teaching and learning and the nature of the mathematics plan needed.

Written reflections were collected at the end of each DMLT meeting. Participants' responses were documented, categorized into themes, and shared at each subsequent meeting. This process enabled group learning to be connected from one meeting to the next. It also served to recognize how group learning grew from meeting to meeting. Team members often referred to the learning journey and acknowledged the collaborative efforts documented in this written feedback.

FIGURE 2

District Mathematics Leadership Team
November 5

AGENDA

8:00 am	Connections—Who's Here?
8:15 am	How Are Students Learning Mathematics? Observe student learning in classrooms in three sessions
9:30 am	Where Have We Been? Five-Year Math Plan Vision Sharing Process Update
10:00 am	Where Are We Going? Taking Action and Monitoring Implementation
10:30 am	Reflection/Next Steps
Future Meetings:	January 16th at the Professional Development Center: EPSS Session
	March 17th at the Middle School: Classroom Learning Observations
	May 14th at the Professional Development Center: EPSS Session

How Did the DMLT Work Systemically to Create a Shared Vision and a Five-Year Mathematics Plan?

The DMLT used a *working systemically* approach (SEDL, 2005) to develop their shared vision of mathematics teaching and learning and create the five-year mathematics plan. Working systemically means attending to the levels, components, and competencies that need to be addressed in order to work effectively toward school improvement. "Levels" takes into account important stakeholders from the district, schools, classrooms, state agencies, local universities, the parent community, and other key community members. "Components" include standards, curriculum materials, instructional approaches, assessment tools, and other resources that play a role in teaching and learning. "Competencies" include a focus on activities such as creating coherence; collecting, interpreting, and using data; ensuring continuous professional learning; building relationships; and responding to changing conditions. The DMLT used this approach as it moved toward its goals.

The DMLT also used a *five-phase process* designed to be used as part of a working systemically approach (SEDL, 2005). The five phases are 1) understanding the system, 2) analyzing the system, 3) planning action, 4) taking action and monitoring implementation, and 5) assessing and reflecting on outcomes. The DMLT worked through phases 1, 2 and 3 during the first year of its work together, ending with a plan for taking action. Year 2 of the DMLT work was scheduled to begin with taking action and monitoring implementation (Stage 4) and conclude with assessing and reflecting on outcomes.

Interspersed throughout the DMLT process were opportunities to examine data collected and organized by a research team from Scaling up Mathematics Achievement (SUMA, 2007), a partnership between a local university and this school district, funded by the National Science Foundation. Access to these data assisted the DLMT in making informed decisions related to mathematics teaching and learning and the 5-year mathematics plan. These data also were contributed to important conversations about the SUMA Capacity Building Model with its components of teacher quality and intentional collaboration; administrative, mathematician, and community support; and quality, aligned, and learned curriculum.

These strategies and processes were situated within opportunities to examine mathematics teaching and learning in the district by doing mathematics together, observing classrooms together, and examining data together. For instance, periodically the DMLT would explore math activities from the adopted curriculum materials, sharing their own solution strategies and discussing how students might approach such problems, with a focus on what these allowed students to learn. The conversations across teachers, administrators, community members, and mathematicians were rich and productive. In addition, the DMLT would periodically meet at a school in order to observe classrooms, and afterward, raise thoughtful questions about the mathematics teaching and learning they saw there. Here, too, the components of the SUMA Capacity Building Model provided a structure for the classroom observations and the subsequent discussions.

What was the Learning from the DMLT Work in Year One?

The artifacts, anecdotes, shared observations, reflections, and informal conversations that took place among DMLT members indicated that a good deal of learning was taking place through the DMLT work. This learning can be organized into the following six themes:

- The importance of the Superintendent's stable leadership, support, and full participation at all meetings, along with the support and participation of other district administrators, made an important difference to the success of the DMLT;
- The importance of a system-wide data collection plan that provided data for use in DMLT discussions and decision-making;
- The importance of creating shared commitments to collaborative learning and a systemic approach to achieve sustainable goals; and
- The importance of focused facilitation of each DMLT meeting.

The Superintendent's support was essential to starting the DMLT process and communicating clear expectations for the work of the team. The Superintendent opened the first meeting by stating the importance of the group's work in creating a five-year mathematics plan and speaking compellingly about he team's role in making a vital difference for students. The support and participation of other

district administrator in DMLT meetings was also a key factor in this effort.

The system-wide data collection, analysis, and reporting that was in place through SUMA made an important difference to the quality of DMLT discussions and decision-making. The SUMA data included student achievement data as well as data from classroom observations, teacher focus groups, teacher surveys of content knowledge, and other sources of data to share with stakeholders. These data informed decision-making regarding the district structures, resources, policies, and professional development needed to ensure a strong five-year mathematics plan.

There was continual reflection both on the work of the DMLT and the kinds of collaboration that supported that work. When the DMLT began, many were unfamiliar with the idea of identifying collaborative group norms or working systemically to effect change in a district. As the DMLT continued to meet, a shared commitment to this way of working grew stronger, influencing not only short-term goals and how they were enacted, but long-term goals as well. Two DMLT members offered the following reflections:

> *Working systemically creates effective change… but it is a slow, community-based process. It's important that all stakeholders actively attend, participate, and contribute to make this work.*

> *I have learned the value in a long-range, systems based approach. Initially my reaction was one of a more impatient, let's get in and fix it person. As our groups have morphed into a longer-range approach, I see that we have the potential to initiate far-reaching, positive change.*

The DMLT felt that it was through this kind of effort that sustainable goals could be achieved.

Focused and planned facilitation of the DMLT meetings was also essential to creating a collaborative culture that was safe for sharing different perspectives; engaging participants in thoughtful, reflective dialogue; assuring the accomplishment of tasks in between sessions; and linking learning from one meeting to the next (Figure 3). It was important for the facilitator to remain objective while also building on the experience and expertise of all members and focusing the learning conversations on relevant, authentic goals. Documenting the group's work as it progressed allowed the DMLT to see the results of their actions as they continue to learn together.

FIGURE 3

District Mathematics Leadership Team
January 14

AGENDA

8:00 am	Connections—Who's Here?
8:45 am	Connections From Classroom Learning Observations at Monumental Elementary School
9:00 am	What Do the Data Tell Us? Presentation and Discussion • MAP Data • K-5 Benchmark Data • SUMA Data from Parent and Teacher Surveys
10:00 am	Break
10:15 am	Next Steps: Deepening Framework Understanding *Choose one component for planning action: Quality Aligned Curriculum, Administrative Support, Teaching Quality*
11:00 am	Algebra Task Force: Embarking on the Journey
Future Meetings:	February 4th at the High School: Classroom Learning Observations March 17th at the Middle School: Classroom Learning Observations May 14th at the Professional Development Center: EPSS Session

What are the Potential Benefits for Continuing the DMLT Structure?

The potential benefits about the value of the DMLT from Year 1, based on written reflections from DMLT members, were cited as important reasons to continue meeting in Year 2. These benefits included:

- The DMLT provided a structure for articulating clear goals for the DMLT and a process for achieving them.

> *The purpose is to have a systems approach for sustainability of determining the direction of mathematics in the district for the benefit of our students.*

To create a five-year math plan to promote (sustain) progress in mathematics learning.

The purpose of our work is to make a difference in math achievement for all of our kids: to do this over a long-term timeline with all stakeholders.

- The DMLT provided a structure for using classroom and school data to discuss issues and make decisions.

  W*hat really worked for me was a long time spent on examining the data and the questions it generated.*

- The DMLT provided opportunities for professional learning and reflection, as well as allowing members to develop caring and productive relationships with stakeholders at different levels over time, thus making it likely that the work of the DMLT could be sustained over time.

  Sustainability of the shared vision should be a key for change.

What are the actions that will enable the vision to be a first step to reunite our district?

What do we do to make the vision our reality?

How will our long-term goals be achieved?

How can we impact learning at the classroom level?

The DMLT is a promising structure because it promotes participation and contributions of diverse stakeholders, provides learning opportunities to build a professional knowledge base for mathematics teaching and learning, builds relationships that contribute to the development of a district educational network, and helps a district achieve sustainable goals. This kind of structure holds promise for many schools and district seeking to undertake similar work.

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APPENDIX 1

Sample Five Year Mathematics Plan

VISION STATEMENT: THE COMMUNITY WILL LEARN, UNDERSTAND AND USE MATHEMATICS AS CRITICAL THINKERS AND EFFECTIVE PROBLEM SOLVERS.

TARGETED AUDIENCE	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
K-5 Schools	K-5 Implementation of Math Investigations	Refinement of Math Investigations use PK-5 Refinement of Math curriculum map (working document) K-5 Math Benchmark Assessments (intro) REL Intervention Program for 1st graders in ½ of our elementary schools. Use of math curriculum maps Implement end of unit assessments and rubrics Explore math intervention programs	Full implementation of MathInvestigations Roll out use of materials to support core Math Investigations program (PDC /PDTs/Specialists) Full use of end of unit assessments and unit rubrics Roll out math intervention program Use of math curriculum maps	Full implementation of Math Investigations Refine support materials Full use of end of unit assessments and unit rubrics Refine math intervention program Use of math curriculum maps	Full implementation of Math Investigations Full use of end of unit assessments and unit rubrics Full implementation of Math intervention program Use of math curriculum maps
Professional Development – K-5 Teachers	PD on Sept. 17 (Investigations) PD on Jan. 8 Investigations and Literacy Strategies in Numeracy)	PD in August for curriculum map Summer Academy IC (7/28-8/1/08) ($450 stipend = $15/hr. x 30) Develop PLCs (Peer modeling and coaching. Looking at student work) Video effective instruction. Developed highly effective teacher-facilitated PLCs that focus on student learning.	Deepen teachers understanding of math content knowledge Highly developed, teacher led PLCs Summer Academy Investigation in the Classroom (IC) and Building Computational Fluency (BCF) Explore Investigations vertical continuum. Explore Peer coaching and modeling through video broadcasting. Pearson Success Net Training Use common district rubrics for grading in End of Unit Assessments.	Deepen teachers understanding of math content knowledge Highly developed, teacher led PLCs Summer Academy Investigation in the Classroom (IC) and Building Computational Fluency (BCF) and Measurement. Continue to explore the vertical alignment in Investigations across grade levels.	Deepen teachers understanding of math content knowledge Highly developed, teacher led PLCs Summer Academy Investigation in the Classroom (IC), Building Computational Fluency (BCF), Measurement and Fractions, Decimals and Percentages.

APPENDIX 1
Sample Five Year Mathematics Plan (continued)

TARGETED AUDIENCE	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Middle Schools 6-8	Implementation of Connected Mathematics Program (CMP)	Establish school based professional learning communities for teachers to collaboratively study student progress, identify key concepts, common assessments, and identify instructional strategies with embedded technology applications to develop critical thinkers. Plan and develop a system to provide students with extra time and support to gain proficiency in challenging math courses. Identify and pilot/ implement math intervention programs (e.g. Voyager, Navigator, Ramp-Up) and Enrichment Programs (e.g. SiMCalc, Tubula Digita) Identify ways to promote math literacy in all curriculum areas. Work in vertical teams with elementary and high school to identify essential mathematics skills and concepts to ensure seamless transition in mathematics. Participate in District Algebra I taskforce.	Highly developed PLC. Finalize development and begin implementation of common assessments both school-wide and district-wide. Implement math literacy strategies throughout the curriculum. Ensure fidelity to district curriculum through professional development and ongoing reflection/refinement of curriculum maps. Work in vertical teams with elementary and high school to identify essential mathematics skills and concepts to ensure seamless transition in mathematics. Refine implementation of intervention programs through review of student data.	Highly developed PLC. On-going revision and review of common assessments to ensure effectives. Ensure fidelity to district curriculum through professional development and ongoing reflection/refinement of curriculum maps. Work in vertical teams with elementary and high school to identify essential mathematics skills and concepts to ensure seamless transition in mathematics. Continue to study intervention systems in place, modify as necessary to produce maximum results.	Highly developed PLC. On-going revision and review of common assessments to ensure effectives Standard-based learning environment evidenced by: • Opportunities for students to make conjectures about mathematical ideas. • Lessons which foster the development of conceptual understanding. • Multiple perspectives/ strategies are encouraged and valued. • Teacher values students' statements about mathematics and uses them to build discussion and work toward shared understanding.

APPENDIX 1
Sample Five Year Mathematics Plan (continued)

TARGETED AUDIENCE	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Professional Development – 6-8 Teachers	Grade Level math Workshops per grade level – one each semester. Professional Development Day – September 17, 2007	Appropriate and Effective use of NMSBA and MAP Data. Pre-AP: Strategies in Mathematics MC2 Summer Math Academy Leadership Team Workshop: Protocols for Effective PLC, June 17-18, 2008 School Based PLC focused on improving student learning Grade level professional develop days will be provided to continue to develop teachers' instructional strategies based on NM standards. Continue Video Club and Lesson Study (a forum for focusing on student learning and sharing instructional practices) as a form of after school professional development. Video Club will meet quarterly. Lesson Study teams will attend three workshops per semester.	Appropriate and effective use of NMSBA and MAP Data. Pre-AP: Strategies in Mathematics Grade level professional develop days will be provided to continue to develop teachers' instructional strategies based on NM standards. Continue Video Club and Lesson Study (a forum for focusing on student learning and sharing instructional practices) as a form of after school professional development. Video Club will meet quarterly. Lesson Study teams will attend three workshops per semester.	Appropriate and Effective use of Data. Pre-AP: Strategies in Mathematics Grade level professional develop days will be provided to continue to develop teachers' instructional strategies based on NM standards. Continue Video Club and Lesson Study (a forum for focusing on student learning and sharing instructional practices) as a form of after school professional development. Video Club will meet quarterly. Lesson Study teams will attend three workshops per semester.	Appropriate and Effective use of Data. Pre-AP: Strategies in Mathematics Grade level professional develop days will be provided to continue to develop teachers' instructional strategies based on NM standards. Continue Video Club and Lesson Study (a forum for focusing on student learning and sharing instructional practices) as a form of after school professional development. Video Club will meet quarterly. Lesson Study teams will attend three workshops per semester.

APPENDIX 1

Sample Five Year Mathematics Plan (continued)

TARGETED AUDIENCE	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
High School Grades 9-12	Implementation of District math Curriculum including problem-solving based lessons to promote math process standards outlined in the NM Math Standards	Establish professional learning communities to study student progress, identify key concepts, common assessments, and instructional strategies with embedded technology applications to develop critical thinkers. Establish common assessments within math depts. Develop new End-of-Course Exams for Algebra I, Geometry, and Algebra II. Identify, pilot, and implement math intervention programs that address student gaps (e.g. Voyager, Navigator, Ramp-Up) and Enrichment Programs (e.g. SiMCalc, Tubula Digita) Work with middle schools to identify essential mathematics skills and concepts to ensure seamless transition in mathematics. Plan and develop a system to provide students with extra time and support to gain proficiency in challenging math courses. Ensure fidelity to district curriculum through prof. dev. and reflection/ refinement of curriculum maps. Develop District Algebra I taskforce to address Algebra I failure rate, Algebra I readiness	Highly developed PLC. Implement common assessments within math departments to guide instruction in each math course. Implement End-of-Course Exams for Algebra I, Geometry, and Algebra II. Work in vertical teams with middle schools to identify essential mathematics skills and concepts to ensure seamless transition in mathematics. Ensure fidelity to district curriculum through professional development and ongoing reflection/refinement of curriculum maps. Refine implementation of intervention programs through review of student data. Continue to conduct district Algebra I Task Force to monitor effectiveness of recommendations.	Highly developed PLC. Work in vertical teams with middle schools to identify essential mathematics skills and concepts to ensure seamless transition in mathematics. Ensure fidelity to district curriculum through professional development and ongoing reflection/refinement of curriculum maps. Continue implementation; revise End-of-Course Exams for Algebra I, Geometry, and Algebra II. Work in vertical teams with middle schools to identify essential mathematics skills and concepts to ensure seamless transition in mathematics. Continue implementation; revise End-of-Course Exams for Algebra I, Geometry, and Algebra II. Continue to study intervention systems in place, modify as necessary to produce maximum results.	Highly developed PLC. On-going revision and review of common assessments to ensure effectives Standard-based learning environment evidenced by: • Opportunities for students to make conjectures about mathematical ideas. • Lessons which foster the development of conceptual understanding. • Multiple perspectives/ strategies are encouraged and valued. • Teacher values students' statements about mathematics and uses them to build discussion and work toward shared understanding.

APPENDIX 1

Sample Five Year Mathematics Plan (continued)

TARGETED AUDIENCE	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Professional Development – 9-12 Teachers	Monthly PLC meeting by course with facilitation from SDS (Kathe)	College Board Training High Schools That Work training Leadership Team Workshop: Protocols for Effective PLC, June 17-18, 2008 School Based PLC focused on improving student learning (Monthly District Presence) Appropriate and Effective use of NMSBA and MAP Data. Two course specific professional develop sessions will be provided to continue to develop teachers' instructional strategies based on NM standards. Continue Video Club and Lesson Study (a forum for focusing on student learning and sharing instructional practices) as a form of after school professional development. Video Club will meet quarterly. Lesson Study teams will attend three workshops per semester.	College Board Training High School That Work (HSTW) training School Based PLC focused on improving student learning (Monthly District Presence) Appropriate and Effective use of NMSBA and MAP Data. Two course specific professional develop sessions will be provided to continue to develop teachers' instructional strategies based on NM standards. Continue Video Club and Lesson Study (a forum for focusing on student learning and sharing instructional practices) as a form of after school professional development. Video Club will meet quarterly. Lesson Study teams will attend three workshops per semester.	College Board Training High Schools That Work training School Based PLC focused on improving student learning (Monthly District Presence) Appropriate and Effective use of Data. Two course specific professional develop sessions will be provided to continue to develop teachers' instructional strategies based on NM standards. Continue Video Club and Lesson Study (a forum for focusing on student learning and sharing instructional practices) as a form of after school professional development. Video Club will meet quarterly. Lesson Study teams will attend three workshops per semester.	College Board Training Appropriate and effective use of data. Continue Video Club and Lesson Study (a forum for focusing on student learning and sharing instructional practices) as a form of after school professional development. Video Club will meet quarterly. Lesson Study teams will attend three work shops per semester.

APPENDIX 1

Sample Five Year Mathematics Plan (continued)

TARGETED AUDIENCE	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
PDTs / PDC Math Specialists	1 Friday/month for math PD -SUMA protocols Begin awareness of math curriculum map Find support materials for District webpage	August, 2008—PD on Math curriculum map PLC Expectations (1 hr/week/1 hr.) Attend Summer Academies (TERC) Professional Development Institute, March 2009 Develop district rubrics for each End of Unit Assessment PDT's will refine Look-Fors Spring Training on Look-Fors	Professional development for Success Net Use common district rubric for each End-of-Unit Assessment. Train teachers on the use of support materials with teachers	Support full implementation of Success Net in schools Continue with math professional development through support of math PLCs in schools Continue to add resources to fill "gaps" in Investigations. Continue with one Friday per month for math Professional Development for PDTs	Continue with supporting full implementation and refinement of Investigations in schools (to include rubrics, looking at student work, District Benchmark Assessments etc.) Begin looking at Math Adoption resources Support school math PLCs Continue Friday math PDT training
Administrators	PD in November, 2007 PLC training, April, 2007	August, 2008—implementation of curriculum maps Spring training on "look-fors" in Investigations classrooms TERC Investigations Principals' Institute (PI) Ensure end of unit assessments are being used for PLC student progress discussions Ensure unit rubrics are implemented	Adult Learning • Look-Fors • Lesson Structure • End of Unit Assessment & Benchmark Training from PDT Ensure end of unit assessments are being used for PLC student progress discussions Ensure unit rubrics are implemented	Adult Learning Here Ensure end of unit assessments are being used for PLC student progress discussions Ensure unit rubrics are implemented	Adult Learning Here Ensure end of unit assessments are being used for PLC student progress discussions Ensure unit rubrics are implemented
Math Advisory Committee (MAC)	Six meetings - Understand and Analyze the System, Plan Action for Student	Three EPSS linked meetings, plus two learning meetings at school sites – Take Action, Monitor Results, Address Unique Challenges, Reflect on Progress, Share and Disseminate Successful Practices, Visit Math classrooms	Three EPSS linked meetings, plus two learning meetings at school sites– Analyze the System, Plan Action for sustainable structures that promote student achievement, observe in Math classrooms	Quarterly Meetings (1/nine weeks) Take Action, Monitor Results, Address Unique Challenges, identify and document sustainable learning structures, observe in Math classrooms	Quarterly Meetings (1/nine weeks) Analyze the system, plan action for sustainability, disseminate professional knowledge base of best practices, observe in Math classrooms

APPENDIX 1

Sample Five Year Mathematics Plan (continued)

TARGETED AUDIENCE	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
MC2	District-wide professional development to develop district mission and plan for mathematics instruction. School-based support at Middle Schools to assist teachers in implementation of standards based mathematics instruction. Build Leadership Capacity for Mathematics in the District Provide Summer Math Academies and Math Courses for teachers K-12.	Provide district based professional development to address specific school needs: Implementing Standards in the SPED Classroom; Addressing the Learning Needs of ELL Students; Differentiating Math Instruction for a Range of Learners, etc. Provide weekly support for grade level PLC and individual teachers to include classroom modeling, observations for intentional learning, and using data to inform the work of the PLC. Build Leadership Capacity (teachers and administrators) Provide Summer Math Academies and Math Courses for secondary teachers.	Provide district based professional development to address specific school needs. Provide weekly support for grade level PLC and individual teachers. Develop inter campus collaboration and professional learning for standards based teaching and learning. Build Leadership Capacity (teachers and administrators) Provide Summer Math Academies and Math Courses for secondary teachers. (Based on Funding)	Based on funding: Provide Summer Math Academies and Math Courses for 6th -12th grade teachers Work with teacher leaders in classrooms, schools and across campuses in supporting effective mathematics teaching and learning Continue to work with administrators in to build leadership for mathematics learning	Based on funding: Provide Summer Math Academies 6-12 th grade and Math Courses Collaboration between school learning sites to support professional development with teacher leaders as the primary support providers Administrators leading mathematics professional development

APPENDIX 1
Sample Five Year Mathematics Plan (continued)

TARGETED AUDIENCE	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
SUMA	January, 2008 – Researchers in classroom observations.	Continue to work with PDTs on use of instruments to gather data from the classroom. Gathering, analyzing, interpreting data and providing feedback to the district to help district determine if capacity is being built for mathematics achievement. Collaborative partnerships with District and NMSU, to include Teacher Researchers and other district members.	Gathering, analyzing, interpreting data and providing feedback to the district to help district determine if capacity is being built for mathematics achievement. Collaborative partnerships with District and NMSU, to include Teacher Researchers and other district members. (based on continuation of funding)	Present final findings from SUMA research to determine what is useful for building capacity for mathematics teaching and learning.	
Parents	District Parent Math Night - -October (Number & Oper.) --November (Algebra)	Parent Math Events at School Sites	Parent Math Events at School Site	Parent Events at School Sites	Math Events at School Sites

Commentary on Critical Issues in Mathematics Education: What About the Assessment Gap? We Need to Address it—Now!

Francis (Skip) Fennell, *McDaniel College, MD*
Mike Caraco, *Burr and Burton Academy, VT*
Beatriz S. D'Ambrosio, *Miami University of Ohio*
Felicia Phillips, *Atlanta Public Schools, GA*
Karen Mirkovich, *Prince William County Schools, VA*
Tom Reardon, *Fitch High School and Youngstown State University, OH*
Gail Yates, *Christian County Schools, KY*

The following thoughts have been influenced by sessions related to assessment presented at the 11th International Congress on Mathematics Education (ICME) held in Monterrey, Mexico in July, 2008.

The No Child Left Behind (NCLB) Act (2001), now referenced using its original name—the Elementary and Secondary Education Act (ESEA), has forced schools and school districts to not only account for the mathematics performance of all students, including student subgroups, but to also to publically report performance data and identify plans to strengthen that mathematics performance.

But it has also spawned assessment and teaching practices that overemphasize state assessments and created a 'teach to the test' mentality as an effort to ensure that more and more students reach a school's Adequate Yearly Progress (AYP) benchmark.

To reach AYP levels and demonstrate proficiency, many state assessments skim the surface as they attempt to measure state curriculum standards that often contain far too many expectations, address concepts and skills that are less than important, overemphasize skills, and have far less emphasis on complex content, problem solving, and rich mathematical problems that require students to show their work. (There are some notable exceptions to this situation discussed in recent NAEP reports.)

Against this reality backdrop, Secretary of Education Arne Duncan recently (June 14, 2009, at the 2009 Governors Education Symposium) announced that to help measure the soon-to-be-released set of common core curricular standards that states agree upon—no small feat—the U.S. Department of Education will provide $350,000,000 to states and state consortiums to create rigorous assessments linked to the new common core standards. (See the New England Common Assessment Program [NECAP] as an exemplar.) This funding will come from the Race to the Top funds available from the American Recovery and Reinvestment Act (ARRA). Secretary Duncan noted that "once new standards are set and adopted you need to create new tests that measure whether students are meeting these standards." He continued, "We need tests that go beyond multiple choice—and we know that these kinds of tests are expensive to develop. It will cost way too much if each state is doing this on its own. Collaboration makes it possible for this to happen quickly and affordably." A reauthorized ESEA/NCLB based on common curriculum standards would present a leaner, more streamlined set of curricular expectations and perhaps more flexible guidelines for reaching ESEA/NCLB.

As common, more focused, and coherent curriculum guidelines are considered along with more flexible guidelines for defining AYP, it is worthwhile to consider assessment issues generally and internationally. While ESEA/NCLB and the National Assessment of Educational Progress (NAEP) highlight achievement gaps within many states, school districts, and schools, yet another gap exists that is problematic. Yes, we have an assessment gap and it needs to be addressed—now.

Ruiz-Primo, Shavelson, Hamilton, and Klein (2002) identify a continuum of assessment distance as a model for articulating the distance between assessment events and their potential instructional impact. Class-based or *immediate* assessments include informal observations, classroom discussion, and artifacts from a lesson. *Close* assessments are those that teachers embed within their lessons or use to monitor progress. Together, *immediate* and *close* assessments define the typical formative assessments used in this country and internationally. *Proximal* assessments are also teacher or classroom driven, but are the formal unit tests or end-of-chapter exams included in curriculum materials and perhaps mandated by the school district, and are more summative in nature. *Distal* and *remote* assessments include the state ESEA/NCLB-required assessments, standardized achievement tests, ACT and SAT tests, and other such assessments and are also summative. These distal and remote assessments serve a purpose and are important. They provide assessment "snapshots" that indicates how, generally, students are doing but the results have little meaning diagnostically, other than to examine particular types of items along with student errors and successes—classic item analysis issues regarding item difficulty and discrimination.

Continuum of Assessment Distance

- **Immediate:** informal observation or artifacts from a lesson;
- **Close:** embedded assessments and semi-formal quizzes following several activities or lessons;
- **Proximal:** formal classroom exams provided by particular curriculum materials and perhaps required by the district;
- **Distal:** criterion-referenced achievement tests such as those required by ESEA/NCLB; and
- **Remote:** broad outcomes measured over time using norm-referenced tests.

FORMATIVE AND SUMMATIVE ASSESSMENTS: While formative and summative assessments are often used as complementary approaches to assessment, all too often, formative and summative assessments are viewed by teachers and students as distinctly different from each other. The point here is that linking formative and summative assessments together can help close the assessment distance in the continuum discussed earlier. Now, perhaps more than ever, the mathematics education community has the opportunity suggest very strongly that the full continuum of assessments are important opportunities for all students to more fully show what they know, and that any reauthorization of No Child Left Behind must consider varied assessments from immediate to remote or formative and summative.

EQUITY AND ASSESSMENT: Many countries successfully meet the needs of their multilingual students in classrooms where the language of instruction may differ from the languages used by students at home. Policies regarding the language of instruction vary tremendously throughout the world and even within countries. The decision in some areas of the United States to prohibit teachers and children from using languages other than English during instruction and on assessments may need serious reexamination, given the experiences of so many countries that embrace the multilingual nature of the members of their classroom communities. These policies have a significant impact on issue of access to educational opportunities, both as a result of opportunities to learn and as a result of their performance on standardized assessments, and need to be addressed.

CLOSING THE ASSESSMENT GAP: There is a gap, an assessment gap, and it certainly needs to be closed—now. We are over-assessing far too many of our students and the assessments are many, varied, and, far too often, not connected to teaching and learning. It is time, right now, to blur the assessment continuum. Teachers need to use assessment to help inform their teaching, to assist them in determining student needs and interventions, and to compare student progress across instructional units and grade levels. From immediate to distal, from formative to summative, the assessments need to be part of a plan—a well-articulated plan that focuses on using assessment to truly assist in the teaching and learning process. To do this right, the mathematics education community in the United States must focus more carefully on issues of equity as it relates to assessment. If we seek evidence of mathematical understandings with varied forms of assessment,

we could paint a different picture of the mathematics achievement of many of our students. The conversation about achievement has to become much more robust, and to do this, our assessment gap must close. It must blend formative and summative assessments if we are to honor and celebrate the knowledge of our students and the knowledge base of the communities to which they belong. This is especially important as we consider the potential of common curriculum standards and assessments.

In closing, we submit the following questions, just as an initial step in considering your own assessment plan, and linking assessment to important issues of teaching and learning:

- What is your state or school district's assessment plan?
- How do you use formative and summative assessments to determine student needs and interventions?
- How does your assessment plan accommodate the needs of mathematics learners whose primary language is not English?
- Is the use of formative assessment a regular component of every teacher's mathematics lessons? How do you know?
- Do students have opportunities to demonstrate what they know via assessments that are not test-like?
- How do you implement and use the data gathered from a full range of assessment opportunities—from immediate to remote and both formative and summative?
- How will your formative and summative assessments change as common curriculum standards become a reality?

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