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Researching Mathematics Teaching in Bilingual–Bicultural Classrooms

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Current wisdom in bilingual education calls for the teaching of language in ways that are authentically connected to content. However, few examples in the literature provide images of what it means to teach meaningful mathematics content in ways that build on diverse students' cultural and linguistic knowledge. The authors of this chapter, a mathematics educator and a bilingual educator, are engaged in research examining the challenges faced by teachers in bilingual and bicultural classrooms in urban schools. This chapter offers an analysis of fundamental issues involved in studying mathematics teaching in culturally and linguistically diverse, urban settings. We discuss and critique a framework that presents a view of teaching practices that integrates concerns about cultural contextualization and meaningful mathematics. We raise questions about research that depicts teaching as either successful or not according to idealized models of practice, arguing that teaching is best understood as existing along multiple, intersecting continua. Finally, we make recommendations for the focus and stance taken by researchers pursuing similar questions.

Educators are under increasing pressure to attend to issues of language and culture in all areas of the curriculum. Although there are many examples in the literature of how to integrate multicultural themes within social studies and literature, there are relatively few examples of what it means to teach meaningful mathematics in ways that build on diverse students' cultural and linguistic knowledge. This chapter explores fundamental issues involved in research that

examines this question. The authors of this chapter, a mathematics educator and a bilingual educator, have been engaged in research on mathematics teaching in bilingual and bicultural classrooms in urban schools. Janine Remillard is a teacher educator with interests in mathematics teaching and learning; Melisa Cahnmann is a teacher educator whose research interests are in literacy and bilingual and bicultural education.

The story of this chapter began in 1997 when a group of bilingual educators from an elementary school in North Philadelphia consulted with Cahnmann about developing equitable assessment practices for their largely bilingual, Puerto Rican student population.[1] Several teachers decided to focus on mathematics during their initial exploration because they believed "numbers were numbers" and thus assessing mathematics knowledge would involve relatively few language or cultural issues (Cahnmann & Hornberger, 2000). Cahnmann then learned there were two primary reasons why this logic was flawed. First, if numbers are really language-free, how might educators explain the well-documented history of Latino and African-American students' poor performance on mathematics assessments relative to their majority counterparts (Cahnmann & Hornberger, 2000; Khisty, 1995; Silver, Smith, & Nelson, 1995)? Second, the new mathematics curriculum adopted by the school appeared more language-rich than any traditional mathematics textbooks in previous years. No longer were students to copy and complete pages of computational exercises; the new mathematics reforms emphasized communication and problems embedded in everyday contexts. Therefore, more questions needed to be asked regarding the relationship among language, culture, and mathematics education.

Cahnmann began consulting with Remillard to understand the goals of these language-rich mathematics reforms from the perspective of a mathematics educator. At that time Remillard was in the initial stage of a multiyear research project on mathematics teaching and learning in an urban elementary school in West Philadelphia. The school served mostly African-American and White students from low-income and middle-class families. She was supporting teachers' efforts to teach mathematics in ways that were accessible to all students in the school, not just higher income, White students who had traditionally been successful. Thus began our collaboration that mirrors a concern

[1]From 1997 to 1999, Cahnmann carried out ethnographic research at this school site. Her original research questions were largely about reading and writing practices among bilingual youth. These questions changed in response to teachers' interests in mathematics and bilingual education.

in current educational research: how to attend to language, culture, and content learning all at the same time (August & Hakuta, 1997; Chamot & O'Malley, 1996; Sleeter, 1997). Likewise, both of us were concerned about prevailing, albeit false notions, that mathematics was acultural and a universal language, and therefore those teaching mathematics were somehow absolved of responsibility for attending to cultural and linguistic differences.

As a result of our work together, we have learned that our two respective fields—mathematics education and bilingual and bicultural education—have only begun to examine what it means to teach meaningful and empowering mathematics in ways that take into account the needs and experiences of culturally and linguistically diverse students. Our current research aims to clarify what is involved in negotiating the terrain between these two fields. We believe that doing this involves moving beyond locating ourselves in one field and extending our hand to the other; rather, this work involves framing contexts where the two are integrated. Our aim in this chapter is to discuss our efforts to do this work as researchers.

We begin with a review of existing research and theory, the myths we view as crucial to dispel, and the gaps in theoretical understanding we aim to fill. We then introduce a framework we have developed to focus on the movement involved along two intersecting continua of mathematics and bilingual and bicultural concerns. Lastly, we raise questions about research and practice that idealize successful teaching or demoralize failure, without a focus on the large area of process and struggle that is more likely to occur between these two extremes (Cahnmann, 2001). We conclude by making recommendations for the focus and stance taken by researchers pursuing similar questions.

EXISTING WORK ON MATHEMATICS AND BILINGUAL AND BICULTURAL EDUCATION

Throughout our collaboration we have found a small number of researchers who, like ourselves, aim to understand the relationship between mathematics and bilingual and bicultural education. For example, Moschkovich (2000) and Khisty (1995) have uncovered some of the linguistic difficulties involved in teaching and learning mathematics in Spanish and English. Moschkovich (2000) described the confusion that can arise for bilingual students between everyday talk and the mathematics register across two different languages. For instance, a single mathematical term such as *menos* in Spanish may have multiple English terms associated with it such as *minus* in "treinta *menos* diez

[thirty *minus* ten]" and *less* as in "diez *menos* que treinta [ten is *less* than thirty]" (p. 87). In addition, second language learners may be challenged by English words such as *table* and *set* that have unique everyday and mathematics meanings (e.g., "set the table" vs. "a set of objects" or "a table of data"). Khisty (1995) found bilingual teachers also struggle when teaching mathematics. Teachers fluent in two languages do not necessarily have command of the mathematics registers of both languages, and often make translation errors in one language or the other. Khisty also found that bilingual teachers, like many elementary teachers (Ball, 1988; Remillard, 1993), tend to be uncomfortable about mathematics in general, regardless of the language of instruction. Teachers' limited bilingual fluency compounded by discomfort with mathematics content exacerbates the difficulties of successful instruction with bilingual and bicultural students.

These concerns over language fluency and mathematical knowledge have been heightened by current reforms that aim to embed students' mathematical learning in everyday situations and emphasize mathematical talk. As mathematics education moves away from rote procedures and rules and toward conceptual thinking, teachers in bilingual and bicultural settings find themselves negotiating unfamiliar mathematical terrain across languages and cultures. Much of the initial reform-focused research concentrated on suburban, middle-class schools, leaving urban and rural schools with little guidance on how to bridge cultural and linguistic gaps. Only a relatively small number of research-producing efforts to improve mathematics curriculum and pedagogy have focused specifically on ethnic minority and low-income communities (e.g., the QUASAR project by Silver et al., 1995; and Project IMPACT by Campbell & White, 1997). Findings from these initial studies suggest that it is possible for urban teachers to offer challenging mathematics to their students. Nevertheless, these studies indicate that progress among teachers and students proceeds slowly and is often hampered by policies and conditions outside the control of teachers such as class size, institutional bureaucracy, and limited resources.

Furthermore, some scholars warn that uncritically embraced reforms that are carelessly implemented may have detrimental effects on students of color (Delpit, 1988) and students from low socioeconomic conditions (Lubienski, 1996, 2000). In other words, reform-initiated practices may do more harm than good if they are not implemented in culturally appropriate ways that are also true to the deep conceptual goals of mathematics instruction. Even when reform-initiated curriculum materials and professional support do make their

way to urban schools they may not improve diverse students' mathematics expertise. The cultural and linguistic biases inherent in many mathematics reform materials can implicitly privilege White, middle-class experience, background knowledge, and assumptions. There is evidence that these biases actually widen rather than reduce the gap between groups (Tate, 1997).

A growing body of research looks at the role of the teacher's cultural and linguistic identity in bridging the gap between students' home experiences and academic curricula that assume White or middle-class experience. Several studies identify the advantages of shared attributes between teacher and learner. For example, Cazden (1988) found that the use of *cariño*, a nurturing communicative style, appeared to contribute to the strong and positive sense of community she found among Mexican-descent teachers and students in a Chicago elementary school. Similarly, Foster's (1989) study described the forms and functions of shared speech style between an African-American teacher and her African-American students and analyzed how such features contributed to her success in the classroom. Other studies illuminate the possible ways teachers and other school personnel can actively build solidarity and rich learning experiences with students who are culturally, linguistically, and socioeconomically different from them (Erickson & Shultz, 1982; Hornberger, 1990).

The studies described above are not specific to mathematics instruction. Rather, they illuminate ways teachers, regardless of cultural or linguistic background, might use culturally contextualized teaching practices, materials, and assessments to educate youth, in all content areas. Studies by Gutstein, Lipman, Hernandez, and de los Reyes (1997) and Gutiérrez (1999) represent the small, but growing number of studies that address such culturally contextualized practices as they pertain to teaching mathematics. Gutstein et al. (1997) present a model for culturally relevant mathematics teaching that developed out of studies of successful middle school math teachers in a Mexican-American community. Gutiérrez (1999) examines the practices of a high school mathematics department that is successful in advancing large numbers of Latino students.

Studies such as those described here offer portraits of idealized mathematics or bilingual and bicultural practice. We believe these studies provide a critical first step in imagining pedagogical possibilities appropriate for bilingual and bicultural settings. However, depictions of polished practice offer few insights into the struggles and challenges involved in developing such practices in urban schools. We see this lack of attention to the process of developing

practices that integrate these two fields to be a critical gap in the literature. Our research with teachers working at the intersection of mathematics and bilingual and bicultural education suggests that success is not an either–or proposition and that a great deal of hard work and partial success lie between the ideal presented in much of the literature and the impoverished pedagogies that both fields seek to eliminate. This terrain is not well understood or studied. We believe that understanding it is critical to improving mathematics learning opportunities for all students, especially low-income students of color who have traditionally had less success in mathematics education (Tate, 1997).

The framework we discuss in this chapter represents our efforts to illuminate the work involved in integrating sound mathematics and bicultural and bilingual pedagogies in the classroom. This framework emerged from our studies of elementary teachers in two urban schools, one largely Latino and African American, the other largely African American and White. We spent 2 years conducting ethnographic fieldwork, including participant observation in 14 mathematics classrooms and formal and informal interviews with teachers and students. A central goal of our research was to examine the challenges and opportunities of teaching in low-income, ethnically diverse settings.

A FRAMEWORK FOR EXAMINING CLASSROOM PRACTICES

In our efforts to conceptualize the relationships among language, culture, and mathematical content in teaching, we draw on a framework designed to examine classroom practices with these dimensions in mind (Cahnmann & Remillard, 2002). The framework, which grew out of our analysis of mathematics teaching in urban classrooms, contains two intersecting continua (see Fig. 8.1). The horizontal axis represents mathematics, and has, at one end, mathematical learning that is built on deep, conceptual understanding and critical thinking. At the other end is mathematics that is built on procedural knowledge and memorization of discrete facts. The vertical axis represents what we call a "contextualized continuum." At one end are lessons that are authentically contextualized within a dynamic view of students' cultural and community experiences (Gutstein et al., 1997). At the other end are lessons that do not attempt to build on students' cultural and experiential knowledge or do so in superficial ways. We choose "culturally contextualized" rather than other terms used in the literature, such as culturally relevant or congruent, to emphasize the critical role that accessible contexts play in supporting students'

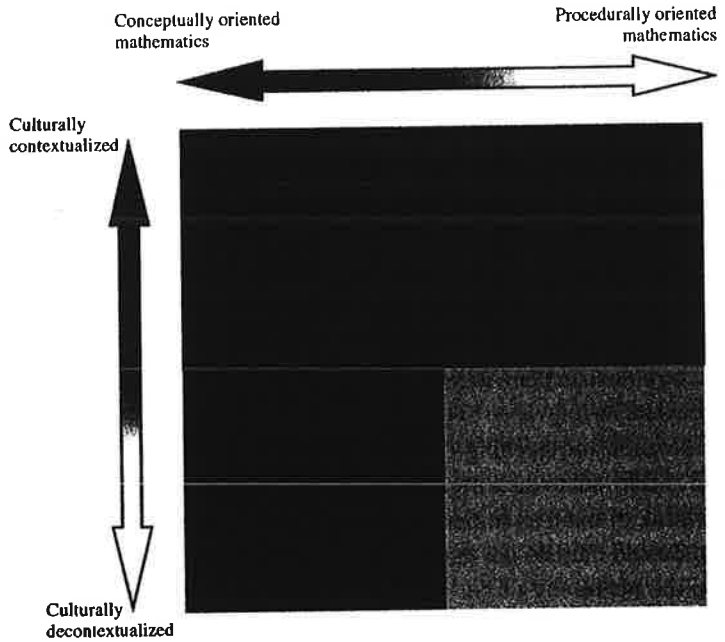

FIG. 8.1. Four-cell matrix representing possible relationships between two intersecting continua.

mathematical learning. Whereas the latter might assume that all mathematical tasks or representations draw on elements of students' home cultures, the former assumes that mathematical learning needs to be embedded in classroom contexts that are accessible to students. We believe it is possible and desirable for teachers to create meaningful contexts in the classroom through shared experiences, rather than explicitly link every math lesson to students' cultural knowledge.

It is our view that accomplishing genuine change in urban classrooms requires teachers to push their practices along each continuum, which involves integrating sound mathematics teaching with practices that are culturally contextualized. Nevertheless, doing so is remarkably difficult because neither continuum is a simple line on which teachers simply reposition themselves by employing a new strategy or textbook. Both the mathematics and the contextualized continua are complex and multifaceted. The following examples focus on the work of two teachers, one from each school, who illustrate the complexities faced by practitioners as they struggle with both continua. We chose the

two teachers, Zoey Kitcher and Linda Arieto,[2] because they were typical of the kinds of partial successes we observed throughout the urban classrooms in the study. The examples revolve around a central teaching instance that is typical of the activities and interactions we observed in their classrooms.

Zoey Kitcher

Zoey Kitcher, who during our study taught third grade at Carter Elementary, provides an example of a teacher whose strength was in the area of mathematics. She wanted students to understand the conceptual underpinnings of mathematics, be able to explain their ideas and understandings, enjoy mathematics and appreciate its relevance to their lives. These commitments were evident in her conversation and teaching. As she put it: "One of the goals is for children to see math as relevant to their life. I'd like them to enjoy math, you know. I'd like them to think of math as something that's fun, that, um that's something that they can do and they do do, that they do it in lots of different ways."

Since the beginning of her teaching career, Kitcher considered herself a progressive educator and tended to embrace practices that involved students in reasoning, solving problems, and exploring conceptual ideas. Thus, the current reforms in mathematics education were a welcome fit. She used curriculum resources that focused on concepts rather than rote procedures and designed lessons that would build mathematical concepts from students' informal experience. When teaching multiplication, she used students' experiences with things that come in groups—such as a six-pack of soda—to help them understand the fundamental idea of grouping. The students brainstormed lists of grouped items, and then considered what they would get if they had more than one group. For example, if one six-pack of cola contains six cans, then three six-packs contain 18 cans or three groups of six ($3 \times 6 = 18$). She extended this focus with a homework assignment, asking students to draw a picture of something they found at home that came in groups. The next day in class she asked them to write three sentences describing their groups along with a number sentence. The example she provided was:

There are four flowers.
There are five petals on each flower.
There are 20 petals altogether.
$4 \times 5 = 20$

[2]We have used pseudonyms throughout this chapter.

When working with students on these activities, she focused on the relationship between addition and multiplication and number sense by encouraging students to count their total items in multiple ways—by ones, using repeated addition, and multiplication. As students shared their drawing, Kitcher used pedagogical approaches that reflected recent reform efforts (National Council of Teachers of Mathematics, 2000). She pushed them to explain their thinking and how they figured out how many in all.

Kitcher was less strong in her ability to make cultural connections with her students. As a White, middle-class teacher, she did not see cultural identity (hers or her students') as relevant to her teaching. Rather, she avoided making specific references to race and class and was disinclined to examine overlaps between race and successful school performance. For example, when asked whether she saw differences in students' involvement according to race, she said that she did. However, she was quick to point out that she attributed these differences to ability, not race. "I have a handful of White kids and they tend to be strong academically. So, you know, do they participate because they're strong or do they participate because they're White?" Because Kitcher viewed the differential participation in her class as a product of ability variation, she was not inclined to question the overlap between race and ability.

This tendency to adopt a color-blind perspective on her teaching allowed Kitcher to overlook ways that her practice may have been culturally biased. Even though she had students draw on their home experiences to find multiplicative situations for homework, she struggled to maintain this connection during the second phase of this lesson. After soliciting students' multiplication sentences, she wanted students to reframe them as a question, which she referred to as a riddle. Rather than stating, for instance, "There are five petals on each flower," she wanted them to pretend they did not know this information and ask, "How many petals are on each flower?" These questions were to be answerable, given what they know from the other two sentences (in this case, the number of flowers and the total number of petals).

Kitcher's mostly African-American students were unable to offer questions when she asked them for their riddles. Instead, they were inclined to restate the information they had. Kitcher made multiple attempts to get the students to ask a question, repeatedly asking, "If I cover this sentence up, what do I not know?" Eventually, one of the few White students in the class produced the "question" she was looking for. Trying again, Kitcher covered a different sentence and asked for a riddle. Again, one of the White students in the class was able to answer after several attempts.

It seemed that Kitcher was not aware that using the riddle in this context may have been an unfamiliar genre for her students. Moreover, her request for a question rather than an answer upset typical classroom norms. Furthermore, when trying to help students understand how to change their statements to a question, Kitcher repeatedly used her own example of petals and flowers, rather than any of the contextualized examples the students had brought from home, such as wheels on a truck, fingers on a hand, or packs of yogurt.

Linda Arieto

Linda Arieto was a third-grade teacher at Peter Towns Elementary. In contrast to Kitcher, Linda Arieto provides an example of a teacher whose strength lies in the domain of cultural contextualization. Arieto, who was Puerto Rican and grew up in a low-income community in the Bronx, shared a great deal in terms of language, culture, race, and class background with her students. She was committed to creating a bridge between her students' home experiences and the academic expectations of school. For example, Arieto used her first language, Spanish, to instruct students in difficult content matter that they might have had trouble understanding in English. She was also skillful using and responding to multiple varieties of language familiar to her students such as Puerto Rican Spanish, Puerto Rican English, Black English vernacular, and standard English. In the area of mathematics, Arieto consistently found and used lessons in the text that made links to her students' cultural backgrounds and urban experiences. She highlighted activities from the curriculum that made the strongest links to students' home experiences. For example, she frequently used number sense manipulatives such as dominoes because they corresponded to a game that is popular in Caribbean culture.

Unlike Kitcher, Arieto was not shy about issues of language, culture, race, and class. She was explicit with her students about the inequities that exist. She frequently taught students explicit lessons about how to avoid the dangerous traps of poverty. For example, she modeled the importance of patience and delayed gratification, linking these practices to skills her students needed on the streets. She hoped to offer a positive example of a Puerto Rican woman who made it out of poverty and into a professional career. As she put it:

> I see my children and I know some of them will be selling drugs on the corner. I know that. Some of them will not reach adulthood. I know that. And it makes me very sad because it's all around them. But you hope that a lot of them will make it. And I keep telling them, I was raised like this. I lived in a terrible neighborhood, I had horrible parents. And I made it. You could do it too, and education is the key.

Arieto was less at ease in the mathematics domain. Where her bilingual fluency allowed her to create connections and establish trust with her students, it was less useful in mathematics teaching. She struggled with the translation of the specialized language used in mathematics and, in particular, those terms and ideas emphasized in the reforms. The school had adopted an all-English curriculum for her third-grade transition class. Arieto's own experience in mathematics was entirely in English in New York City schools. Her Spanish–English dictionary was not always helpful, especially when translating the mathematics language that is particular to the new mathematics series. For instance, she struggled to translate newly coined terms such as "frames and arrows" used by the new math series to describe relationships between operations. Arieto also found that cultural references, such as a discussion of height and velocity through kite-flying in a grassy park, did not make sense to her students. She struggled with lessons that made assumptions about knowledge that students did not have.

Arieto's own discomfort with mathematics also limited the extent to which she was able to implement the reform ideas in her practice. Several lessons we observed showed evidence of good intentions—cultural connections, high levels of student involvement, and invitations to communicate about mathematics—that were never fully realized. For example, during one lesson Arieto had students work in pairs using *topitos* (dice) to fill out a chart indicating numbers of pennies, nickels, dimes, quarters, and dollars and their corresponding values. Two nickels and a dime, for example, summed to 20 cents. Each student was to roll the die five times per turn and decide where to place each of the numbers to have the highest total at the end of the game. If a student rolled a 2 she would have to decide whether to place that 2 in the dollars, quarters, dimes, nickels, or pennies column, aiming to get a higher score than her opponents (see Table 8.1).

TABLE 8.1

Model of the "Making Change" Activity Sheet, Player 1

	P	*N*	*D*	*Q*	*$1*	*Total*
Turn 1	2	5	3	6	4	$ 6.07
Turn 2	1	3	3	2	6	$ 6.96
Final score						$13.03

As the students worked on the activity, many became confused about the directions. Some students wrote down the coin values (e.g., $.25, $.10, etc.) rather than the value rolled on the die. Others were adding the sum of the rolled dice numbers, rather than the value of the coins (see Table 8.2).

TABLE 8.2

Two Examples of Student Errors in "Making Change" Activity Sheet

	P	*N*	*D*	*Q*	*$1*	*Total*
Turn 1	2	5	3	6	4	20 (2 + 5 + 3 + 6 + 4)
Turn 2	.01	.05	.10	.25	1.00	$ 1.41

Arieto tried several times to revise the lesson to make it easier for students to understand, but this ended up making the instructions even more complicated and unclear. Eventually, she became confused and frustrated. Convinced that students were not ready for such a lesson, she announced, "I'm gonna have to drill the coins every minute!" She spent the remainder of the class time leading the students in counting together by fives.

In another lesson we observed, Arieto brought in her personal collection of Matchbox cars for students to use in a graphing lesson. As students began counting and graphing the cars, there was no indication that accuracy in counting was important. When confusion began about how to graph cars with more than one color, Arieto first stressed each student's responsibility for making these decisions. However, as students' talk about these decisions became loud and chaotic, Arieto revoked her earlier decision and told students which color to assign to particular cars. When a boy held up a burgundy car, for example, and asked, "*Es púrpura maestra?* (Is it purple, teacher?)," Arieto shook her head and told the boy to count that car as red.

THE COMPLEXITIES OF EACH CONTINUUM

These two teachers' experiences with reform-oriented mathematics in bicultural and bilingual settings illuminate the complexities of the mathematics and cultural continua. They illustrate different yet complementary challenges teachers face when trying to move their practices toward conceptual understanding and critical thinking in ways that validate students' diverse cultural and linguistic experiences. As we look across the struggles faced by these teachers, as well as those from data not described here, we see three types of

challenges involved in this work. The first is related to the knowledge required of teachers to work within both domains. The second is related to how teachers use this knowledge to find or develop tasks that are both mathematically sound and culturally appropriate. The third is the ongoing challenge of upholding the intent of the task through the "in-flight" (Jackson, 1968; Ulichny, 1996) bumps that emerge while students work on it.

New and More Knowledge

As the framework suggests, it is not enough for a teacher to have strong cultural or mathematical knowledge alone. Working in these complex areas requires that teachers develop knowledge of both culture and mathematics. Moreover, this knowledge needs to be deep and substantive rather superficial. For most teachers, this degree of understanding in both areas is unfamiliar.

In the area of mathematics, pushing one's teaching along the mathematics continuum toward meaningful mathematics requires conceptual understanding and willingness to explore new mathematical ideas with one's students. Arieto's "Making Change" lesson is a reminder that reforms in mathematics education often require much more mathematical knowledge than is common among most elementary school teachers. When using conceptually based mathematical tasks, teachers frequently confront uncertainty about how to guide students. As teachers enhance their understandings of mathematics, they are more likely to use this new knowledge as a guide in making pedagogical decisions.

In the contextualized continuum, teachers need to develop knowledge about their students—how they identify themselves culturally, their language, their experiences at home and in the world. They also need to learn to analyze their own cultural identity and language use as a way of reflecting critically on their practices. The difficulties Kitcher had in reaching her mostly African-American students illustrate challenges teachers, particularly those from White, middle-class backgrounds, face along the contextualized continuum. Although the tasks she gave were designed to develop an understanding of multiplication as it occurred in students' daily lives, she had difficulty recognizing ways that the task and the example she used were inaccessible to students.

Challenging and Meaningful Tasks

The second challenge presented by the two intersecting continua involves using one's knowledge to select, develop, or adapt tasks that have mathemat-

ical integrity and are accessible and engaging to one's particular students. As both teachers illustrate, it is possible for mathematical tasks to be superficial from either a mathematical or a cultural perspective. Arieto, for example, frequently used tasks that involved dice, dominoes, or Matchbox cars because they had meaning to her and she believed her students would be enticed by them. Nevertheless, as the graphing and making-change activities described earlier suggest, the tasks were underdeveloped in terms of mathematical learning goals. Kitcher, on the other hand, was able to develop tasks that focused on meaningful mathematical ideas, but struggled with how to make them accessible to her predominantly African-American students. Students who were familiar with giving answers had difficulty changing their answers into questions or riddles. It is not surprising that the task of making riddles was suggested by the curriculum she was using, because pedagogical styles and curriculum that are most common in American schools assume that certain forms of communication are universal rather than particular to the dominant culture (Delpit, 1988).

Through our interactions with teachers, we have observed a tendency to equate cultural congruence and accessibility with "fun." In other words, tasks that are fun for students to do are assumed to be mathematically and culturally accessible. We have found that tasks that lead to high degrees of student involvement or enjoyment are not necessarily indicators that students are involved in meaningful mathematical learning. One challenge that teachers in urban settings face is to find tasks that are engaging and enjoyable to students and that make important mathematical ideas accessible.

Managing Tasks In-Flight

A final challenge illustrated by both teachers on numerous occasions involves upholding the intent of the mathematical task in the midst of one's teaching. In the process of implementing mathematical tasks, teachers find themselves making impromptu decisions in response to students' actions, questions, struggles, and confusion. Although some of these instances might be anticipated, they cannot be planned. Teachers rarely know precisely which questions will emerge and exactly how they will manifest themselves among a particular group of students. Such improvisational moments are an inherent part of teaching; however, they are more common in classrooms where teachers are trying to cross cultural and linguistic boundaries and when they are trying to engage students in mathematical thinking and problem solving.

One of the dilemmas that teachers frequently face when engaging students in exploring mathematical ideas involves balancing classroom control with students' intellectual autonomy. Although these two goals are not necessarily mutually exclusive, many teachers accustomed to controlling and directing students' learning struggle with sharing intellectual autonomy and decision making with students, even when they believe that helping students develop as mathematical thinkers involves relinquishing some degree of intellectual control. In the graphing lesson, described earlier, Arieto wanted students to think for themselves and make their own decisions about how to count the irregular cars. However, as soon as the noise rose above her level of comfort, she decided to revoke that freedom and replace it with a more controlled approach.

The emergence of student confusion also requires teachers to make on-the-spot decisions about how to respond. As both Arieto and Kitcher illustrate, student and teacher confusion is more likely when teachers are negotiating unfamiliar, complex terrain, whether it be mathematical, cultural, or both. In many cases, spontaneous mathematical interactions have the potential to lead to significant learning (Remillard, 1996, 2000; Remillard & Geist, 2002). Nevertheless, because they require action in the moment, these interactions place extraordinary demands on teachers. When these demands get beyond a teacher's grasp, he or she is likely to reign in and simplify the task, limiting its potential richness (Stein, Grover, & Henningsen, 1996). We saw Arieto reduce and simplify the task at hand when she and students became confused during the making-change and graphing lesson.

For teachers like Arieto and Kitcher, who are negotiating multilayered, unfamiliar terrain, the particular cause of the confusion may be unclear. For example, Kitcher attributed her students' difficulties coming up with a riddle to limited mathematical understanding. From the observer's perspective, the confusion appeared to grow out of a cultural mismatch. Heath (1983) argues that most critical cultural mismatches occur within the context of routine classroom interactions. Ironically, Kitcher's inclination in addressing the students' confusion was to return to the same mathematical explanation. The challenge for teachers is to develop both mathematical and cultural knowledge that they can draw on during these improvisational moments.

CONCLUSION

Our aim in examining challenges faced by teachers in urban schools is to focus analysis on the bumps and barriers teachers face when trying to integrate

sound mathematics teaching in bilingual and bicultural settings. Much of the research available in this area offers either images of teachers who have successfully overcome these challenges or images of teachers who have failed. Research from either genre—studies that focus on successful practices or those that describe and critique unsuccessful and undesirable practices—have brought to light many of the subtle, and not so subtle, biases inherent in mainstream teaching practices and identified the consequences of teaching practices and curriculum that exclude non-White, non-middle-class students. Research in both these areas has provided a critical first step in articulating problems in current practices and offering possibilities and alternatives. At the same time, looking at teaching as either successful or failing oversimplifies the demands of helping all students learn meaningful mathematics and ignores the process of movement along each continuum.

Our analysis of the challenges inherent in the work of teachers bringing together both domains leads us to offer a second step in this research that highlights the struggles teachers confront as they seek to improve their teaching. We believe *portraits of struggle*, that is narrative and interpretive accounts of lived moments of practice, can move the field beyond identifying appropriate or inappropriate practices to understanding the work involved in improving practice (Cahnmann, 2001). In using the term portraits of struggle, we are referring to research that seeks to understand and explain the struggles faced by practitioners as they grapple with the complex demands of teaching meaningful mathematics in urban schools. Our aim in using the framework to examine teaching practices is to emphasize the struggle teachers engage in as they seek to improve their teaching.

We believe that the understanding of teaching offered by research that focuses on struggle is critical to improving the field of bilingual and bicultural education for two reasons. First, research that seriously examines and makes explicit the struggles that teachers face acknowledges and makes visible the real, multidimensional work of teaching. A clearer understanding of teachers' struggles can stimulate changes in the supports and resources available to teachers. This knowledge can also guide the design of professional learning opportunities specifically for teachers in bilingual and bicultural settings. Second, a focus on the struggles inherent in the work depicts teaching as a dynamic process, rather than a finished product. A view of teaching as dynamic assumes that change is possible and natural. Polished images of practice, on the other hand, contribute to mainstream views of teachers as either masters or inadequate. In light of the extraordinary pressure on teachers, we argue for

conceptualizing the profession as an ongoing learning process. Thus, teachers and the researchers, administrators, and public with whom they work will be better prepared to support and encourage teachers' growth rather than condemn less-than-perfect practice. For these reasons, we urge scholars of teaching in bilingual and bicultural settings to engage in analyses that complicate notions of success and failure that have dominated the research landscape and to theorize the nature of struggle.

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