in culture and language, and cultural specialists with an interest in mathematics education. CEMELA offered faculty, doctoral students, and post-doctoral researchers a space to consider the ways in which research could inform what we know and need to know about improving the mathematics education for Latino/a children and youth. Collaborations across institutions included summer institutes, research symposia, and presentations at national and international conferences. Several of the chapters here are the result of these very fruitful collaborations, across disciplines and now across space.

Although CEMELA was a galvanizing organization for many of the authors in the volume, we are confident that the research and attention to improving Latino/a performance in mathematics will continue. If this volume motivates other researchers to join in the effort, then it will have been a great success.

We would like to thank the authors in this volume for their commitment and patience and the series editors for their support. We would also like to thank Hersh Waxman and Yolanda Padrón for their series’ editorship. Esperanza Zamora assisted whenever we needed her. We are also indebted to Nancy Rosenbaum, whose skillful and careful proofing and formatting contributed much to the accuracy and coherence of the book.

Last, but not least, we would like to thank our families for their continued support.

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CHAPTER 1

LATINOS/AS AND MATHEMATICS EDUCATION

Why This Book Now?

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As the title of this volume suggests, we have chosen to compile a book that addresses the mathematics education of Latinos/as, a specific cultural group. But why would researchers focus a volume on the mathematics learning and teaching on any single group, and specifically one defined by ethnicity? The rich history of research on girls’ and women’s experiences in mathematics offers one example (e.g., Walkerdine, 1998), but gender is clearly something different than culture. After all, is not mathematics a largely culture-free discipline, in which language plays but a minor role?
We argue that this misguided view is, in fact, partly responsible for the mathematics underperformance of Latinos. And it is this underperformance that provides our first compelling reason for a focus on Latinos/as. Like other “minority” groups in the U.S., Latinos/as score well below their dominant culture counterparts in mathematics. We point to data from National Center on Educational Statistics showing that Latinos generally score about a standard deviation lower on tests of mathematics achievement than their white counterparts (Jencks & Phillips, 1998; Rumberger & Gandara, 2004). Overall, 4th and 8th grade scores on the National Assessment of Educational Progress (NAEP) mathematics assessment increased in 2009; however, Latinos continued to score among the lowest, and from 1990 to 2009 the gap in the scores for whites and Latinos did not change significantly (http://nationreportcard.gov/math_2009/). The 2009 NAEP results show 44% at or above proficient for white students compared to 17% for “Hispanic” in 8th grade mathematics; for that same grade level, 17% white and 43% Hispanic are below basic (And, Fox, & KewalRamani, 2010). In spite of the overall consistency in scores, the achievement gap is particularly acute for mathematics achievement at the secondary level, where the white–Hispanic mathematics score difference for 17-year-olds has increased substantially since 1960 (Perie et al., 2005). This puzzling finding has educators and researchers asking more questions about the persistent underachievement of Latinos, the nation’s largest “minority” group at 12% of the total population, a figure that increases to over 25% when we count only those under age 25 (Therrien & Ramirez, 2000), and has generated a call to action at several governmental levels. Moreover, we want to point out that Latinos are the least educated among the nation’s major racial and ethnic groups. More than 27% of Latinos, compared to just over 4% of whites, have less than a ninth-grade education (Snyder & Dillow, 2010). The dropout rate for Hispanics is twice the average for whites, 6.0 and 2.8, respectively (Stillwell, 2010), although these dropout figures are disputed. For instance, (Gándara & Contreras, 2009) estimate that over 50% of Latino youth do not receive a diploma after four years of high school. Another aspect of concern is parental level of education: About 40% of Latino children ages 6 to 18 have a parent with less than a high school education, compared to about 6% for white children (Ard et al., 2010).

The consequences of Latino underperformance in mathematics is made clear in more than just test score and dropout data: Latinos are awarded only a small fraction of all science and engineering degrees, earning 7.1, 4.1, and 4.3% of bachelor’s, master’s, and doctoral degrees, respectively (Chapa & De La Rosa, 2006). Relative to other ethnic groups, these figures are unacceptably low and reveal the real-life consequences of an education system that is failing Latino/a students in mathematics and the sciences.

Among the reasons we might count as encouraging a focus on Latinos/as is that the student population is growing rapidly and therefore presents a prima facie reason for concern. While it is true that Latinos/as are indeed a large and growing sector of the U.S. population and an increasing number of school age children in the U.S. are from this population, we must be cautious in allowing population shifts alone to drive research and policy interests. Nevertheless, the data paint a compelling picture of the future. Latino/a population in the U.S. in 2006 was reported to total approximately 44 million or 14.8% of the total U.S. population (Passell & Cohn, 2008). This is an increase from 12.5% in 2000 (Therrien & Ramirez, 2000) and 14% in 2005 (Passell & Cohn, 2008). Projections for 2050 estimate that Latinos/as will then make up about 29% of the U.S. population. Latinos/as also represent a large portion of the foreign-born population at 44.6% (Passell & Cohn, 2008). Latino/a children are a significant and growing student population in K-12 classrooms. In 2005–2006 Latinos/as accounted for approximately 19.8% of all public school students, a 55% increase from 19.7% in 1993–1994 (Fry, 2007). Latino/a students in 2001 constituted the majority in virtually all the major urban school districts in the country (Young, 2002). It is reasonable to expect that as the Latino/a population grows and extends to other areas and regions in the U.S., many public school teachers in this country will be teaching Latino/a children. Finally demographic data also show that the great majority of the Latino population is low-income or working class: Over a quarter (28%) of Latino children (under 18 years) live below the poverty level, a condition that is clearly affecting their preparation for and nature of their schooling (Lee & Burkam, 2002; Moll & Ruiz, 2002).

We do not dispute the demographic forecasts predicting the growth in the number of U.S. Latinos but find this argumentation troubling because it sometimes promotes, often inadvertently, a panic among non-Latinos, especially whites, who see a growing Latino/a population as a threat to “established” cultures in the U.S. Gimenez (1997) points out the dangers of media portrayals of this growth when she writes,

The mass media and politicians exploit data about the youth, higher fertility, and growth rates of the “Hispanic” population in ways that, ultimately, intensify racist fears among those worried about low white fertility, increase the likelihood of conflict with blacks (who see their communities competing for scarce resources with an ever-growing “minority” group), and strengthen stereotypes about “Hispanic” cultural traits. (1997, p. 227)

Similarly, López (2008) writes:

There is a growing anti-Latino sentiment percolating across the nation. Although Latinos represent over 14% of the U.S. population, dominant dis-
courses frame us as a threat to the social and moral fabric of the United States, as well as a drain to social services. These rational discourses...and representations of Latino immigrants are important because they represent racist racial projects that shape the allocation of resources. (p. 45)

To our minds, Latino underachievement in mathematics should be of the utmost concern to educators, policymakers, and the community, regardless of demographic trends, and we should never allow demographic data to cause panic among educators and policymakers. To employ the "shocking" growth in the Latino/a population argument as reason alone for concern strikes us as needless rhetoric.

If mathematics education has something to learn from research specifically on Latinos/as, then we have an obligation to describe, in the most useful manner, who Latinos/as are. Thus far in this chapter we have been using the term Latino/a as a general descriptor for a population, but this term can obfuscate important differences among groups of people, even those who all may self-identify as Latino/a. Important differences such as the length of residence in the United States, language proficiency in English, language proficiency in Spanish, prior school experience, living in an urban or rural region, and socio-economic status are all important distinctions among Latinos/as when considering instructional programs. These differences suggest that the needs of Latino/a students are both diverse and specific to individual students. Consider, for example, two 14-year-old Latina students, one of whom is a recent arrival from the state of Jalisco, Mexico, who has already missed three years of school, who is fluent in Spanish orally but is not yet proficient in writing or reading. This student will have very different needs in the mathematics classroom when compared to a student who, although also a recent arrival, has not missed any school in her native Monterrey, Mexico, completed a year of college-track algebra in Spanish and is highly literate in Spanish and close to oral proficiency in English. These two immigrant Latina students may have very different schooling experiences than, say, a second generation student whose parents immigrated from Michoacan, Mexico 20 years ago. She has been to school only in the US, speaks Spanish at home, and is, of course, literate and fluent in English. In spite of these differences, all three students would be identified—and likely self-identify—as Latinos.

Taking a wider look at the term Latino/a, we recognize that culture is a complex phenomenon and that attempts at generalizations often lead to dangerous stereotypes (González, 1995). Nevertheless, we do recognize an obligation to provide some provisional commonalities. The foremost manner to learn what makes a Latino/a a Latino/a is to become connected to a community of people who identify as such. Direct experience has no peer when it comes to cultural learning/acquisition (Téllez, 2010). On the other hand, Latino/a scholars such as Rúa (2005) have developed the notion of "latinidad" as a representative identity rooted in a history of European colonialism, U.S. imperialism, and a stigmatization by the dominant ruling classes in the Americas. These collective experiences emerge as cultural "expressions" in observable behavior such as religion. Rúa suggests that the Latino/a solidarity found during the civic marches of May 2006, when Latinos/as of various national ties came together to protest the draconian Border Protection, Antiterrorism, and Illegal Immigration Control Act of 2006, offers clear evidence of latinidad. Still, she is careful to point out that a broad cultural identifier such as latinidad can be used to over-generalize and thus erode Latino/a identity as easily as it can empower.

We have used the term Latino/a in this chapter (partly to recognize the importance of gender in marginalized communities), but we want to make clear that the research in this volume is not intended to be a representative sample of all Latino/a learners or communities. Based on the physical locations of the universities connected via the CEMELA project, the majority of the studies herein focus on Latino/a communities whose national heritage is primarily Mexican. We fully recognize that research in immigrant communities and those of color is highly contextualized and rough generalizing can result in a morass from which even the most thoughtful researcher cannot escape. It is our hope that this volume may inspire additional mathematics education researchers to conduct research in a wide array of Latino/a communities.

A BRIEF REVIEW OF THE RESEARCH ON LATINAS/OS AND MATHEMATICS EDUCATION

Among the most important reasons for studying Latinos/as specifically, and perhaps the most important reason for researchers, is that few empirical studies have focused on mathematics learning or teaching among Latinos/as, and the extant research is quite narrow in scope and theoretical orientation. For instance, early studies of Latino, bilingual students learning mathematics framed the "problem" as one entirely owing to linguistic challenges: solving word problems, understanding individual vocabulary terms, or translating from English to mathematical symbols (Cocking & Mestre, 1988; Cuevas, 1983; Cuevas, Mann, & McClung, 1986; Mestre, 1981; Spanos & Crandall, 1990; Spanos, Rhodes, Dale, & Crandall, 1988). Although we value these foundational studies for directing our attention to the role of language in the learning of mathematics, the research corpus has largely failed to address the role of bilingualism as a linguistic resource—instead of a challenge to be overcome—as well as divorcing language from its cultural roots. In the following paragraphs, we devote attention to these early
studies, primarily because they provide a window into the history of the research and offer a portal to the research featured in this volume.

Early research with Latino/a learners focused primarily on arithmetic computation and solving traditional word problems (see Moschkovich, 2007b, 2007d, for reviews of early research). One paradigmatic set of studies (several with adults and several with elementary students) focused on arithmetic calculation. Several studies explored adults’ preferred language during computation and compared monolinguals and bilinguals in terms of response times. These studies were typically concerned with individual students calculating one, two, or three-step problems using the four arithmetic operations. A second paradigmatic set of studies focused on word problems. Several studies examined how students translated traditional word problems from English to mathematical symbols.

While many early studies used narrow conceptions of mathematical activity and focused on quick performance on arithmetic computation, a few early studies with young children used Piagetian tasks (see work by de Avila, 1988, for example). Later studies developed a broader view of mathematical activity, examining not only responses to arithmetic computation but also reasoning and problem solving (e.g., Mestre & Gerace, 1986), detailed protocols of students solving word problems (e.g., Spanos et al., 1988), the strategies children used to solve arithmetic word problems (Secada, 1991), and student conceptions of two digit quantities (Fuson, Smith, & Lo Cicero, 1997). This progression is not surprising since the fields of cognitive psychology and mathematics research moved in a similar direction in framing mathematical activity.

The majority of studies involved two paradigmatic scenarios, carrying out arithmetic computation and solving word problems. Therefore, conclusions could only be limited to these two mathematical topics. It is not possible to generalize from studies on arithmetic computation and algebra word problems to other topics in mathematics such as geometry, measurement, probability, or proportional reasoning. Most of the early studies used narrow conceptions of arithmetic or algebra. Studies focusing on response time during arithmetic computation tell us little about strategies or conceptions participants use to carry out these computations. Studies that focused on translating word problems to algebraic equations tell us little about participants’ algebraic thinking.

Narrow conceptions of mathematics that focus on arithmetic computation or word problem translation while ignoring strategies, reasoning, and conceptual understanding constrain mathematical activity to lower-order cognitive skills and limit our views of what constitutes mathematical proficiency. Since much of the early research for this student population focused on lower-order cognitive skills, and only a few studies went beyond computation and translating word problems, it is not possible to reach conclusions for Latino/a students concerning higher-order mathematical thinking or other aspects of mathematical proficiency such as conceptual understanding.

Research studies are needed for this student population that include broader notions of mathematical activity. This can be accomplished by expanding mathematical topics beyond arithmetic and algebra, considering conceptual understanding as well as procedural fluency, or examining how students use and connect multiple mathematical representations. The chapters in this volume expand the research base for this population by using broader notions of mathematical activity in precisely these ways.

We also need more research on Latino/a populations that use current views of mathematical activity using, for example, perspectives that move beyond seeing mathematics learning only as an individual cognitive phenomenon. Recent research in mathematics education provides a view of mathematical activity as developing socio-mathematical norms (Cobb, Wood, & Yackel, 1993), presenting mathematical arguments (Forman, 1996), participating in mathematical discussions (Lampert, 1990), and participating in mathematical discourse practices (Moschkovich, 2007b). Situated perspectives of cognition (Brown, Collins, & Duguid, 1989; Greeno, 1994; Lave & Wenger, 1991) present a view of learning mathematics as learning to mathematize situations, communicating about these situations, and using resources for mathematizing and communicating (Greeno, 1994). These perspectives assume that learning is inherently social and cultural “whether or not it occurs in an overtly social context” (Forman, 1996, p. 117), that participants bring multiple views to a situation, that representations have multiple meanings for participants, and that these multiple meanings for representations and inscriptions are negotiated.

Although focusing on arithmetic computation and word problems may have been sufficient in the past, this emphasis does not include current views of mathematical activity or instructional practices in many classrooms. The research presented in this volume demonstrates a next step in the research on Latino/a mathematics learning by integrating sociocultural perspectives and studying more complex forms of mathematical activity, such as working on projects and using multiple mathematical representations.

EXPECTATIONS AND PREVIEWS

We believe that the most important contribution of this volume is that each and every chapter assumes that mathematics instruction for Latinos/as can be based on the resources to be found in culture and language. By inverting the deficit perspective, we believe this volume redresses the shortcomings found in some of the previous literature. The authors frame language (i.e., bilingualism) not as an obstacle, but as a resource for mathematical
reasoning. Several address the notion of cultural variation not as a liability but as a resource. In this view, educators reframe culture as a focus on resources (i.e., those practices, objects, inscriptions, or people that connect mathematical concepts to student thinking and experiences, both in and out of school).

Section on Latino/a Students, Learners, and Mathematics Education

The chapters in this section address the need to focus on students and learners in order to better understand their experiences, learning, and language use in mathematics classrooms. This section begins to address questions about Latino/a students’ experiences in classrooms: how they relate to curricular models, express resistance, and use language.

Nancy O’Rode’s chapter, “Latino/a Students’ Understanding of Equivalence: Use of Two Standards-Based Curricula in Eighth Grade Algebra” describes the resources Latino/a students use to make sense of mathematics. The study examines how Latino/a students use resources related to two standards-based curricula to develop understanding of equivalence, a fundamental concept in algebra. The study focuses on the concept of equivalence and examines how students used two types of resources, language and curricular models, to solve problems involving equivalence. This study documents how students from two algebra classrooms used resources to solve equivalence problems during interview tasks. The Latino/a students in this study engaged with standards-based curricular materials that encourage communication, reasoning, and problem solving and were in a classroom environment that provided many opportunities for students to engage in conversations about mathematics.

The chapter by Zahnri and Moschkovich, “Bilingual Students Using Two Languages During Peer Mathematics Discussions: ¿Qué Significa? Estudiantes Bilingües Usando Dos Idiomas en Sus Discusiones Matemáticas: What Does it Mean?” uses classroom data to consider several competing hypotheses about why student codeswitch during mathematical discussions. The chapter extends Moschkovich’s (2007b) work by showing how the use of two (or more) languages by bilingual (or multilingual) students provides a set of linguistic resources for managing the social and cognitive demands of mathematical discussions. The analysis considers the possible functions of using two languages during mathematical discussions in light of alternative theories about language in general and bilingualism in particular. The chapter addresses competing hypotheses about students’ use of two or more languages in mathematical discussions using theory, previous research findings, and examples from the two excerpts to consider the merits of each of these hypotheses in turn.

Heather Cavell’s chapter examines the resistance by four fifth-grade Latino/a students in response to the classroom environment and teacher practices. The study was framed using Solórzano and Bernal (2001), Yosso (2000). Solórzano and Bernal (2001) place resistance into several interrelated themes: reactionary behavior, self-defeating, conformist, transformative, and resiliency. Resistance provides students with a means to gain control and connection to educational spaces. Resistance can also be seen as a threat by educators and is often considered an attribute of student failure. The analysis considers the forms of resistance to the classroom norms, teacher, and mathematics that students used and explores the experiences prompted students to use these forms of resistance. The case studies showed that communication between the teacher and students was critical to providing quality instruction while not suppressing cultural values.

Section on Latino/a Community, Parents, and Mathematics Education

Research focused on working-class, minoritized communities highlights the power issues that characterize parents-schools relationships (Henry, 1996; Lareau, 2000; Reay, 1998, Vincent, 1996). Minoritized parents’ voices are often not heard (or listened to) in school settings. Within mathematics education, the work of Civil and colleagues argue for the need for schools to recognize the experiences and backgrounds of families as resources towards their children’s schooling (Civil & Andrada, 2003; Civil & Bercier, 2006; Civil, Bratton, & Quintos, 2005; Civil & Menéndez (2011); Civil & Planas, 2010; Civil & Quintos, 2005; Quintos, Bratton, & Civil, 2005). Their research centers on a non-deficit view of working-class Latino/a parents and on the need to establish a dialogue between communities (parents) and schools (teachers and administrators) in which different views about teaching and learning of mathematics are shared towards the goal of improving the mathematics education of Latino/a children. This body of work informs us of Latino/a parents’ perceptions about the teaching and learning of mathematics underscores the concept of valorization of knowledge, by which parents (as everybody else) often have well-established beliefs about content and pedagogical approaches in mathematics. However, as Quintos, Bratton, and Civil (2005) write, “Alternative approaches are often not treated equally…In this context, the parents’ or home method is not given the same value as the teacher’s or textbook method. Historical relations of power at the schools can not only be reproduced but also exacerbated through mathematics education” (p. 1189).
The chapters in this section address the continued need for a stronger and meaningful communication between schools and Latino/a parents. This communication should encompass the varied views about the teaching and learning of mathematics that the different participants (in particular, parents and teachers) may have, as well as considerations for the role of language in mathematics education, in particular in contexts where English is the dominant language in the school while Spanish is the main language in the home.

The chapter by Morales, Vojvodic-Ivanovic, and Khisty gives an example of the potential of multi-generational setting to generate rich mathematical engagement for Latino/a students. Situated in the context of an after-school project and the context of children's homework, the chapter illustrates the use of cultural and linguistic (English and Spanish) resources in a mathematical environment around probability and arithmetic based games. The participants include elementary school-age children, the mothers of some of them, and undergraduate and graduate students. The chapter focuses on the case of one student and his mother and highlights the connections between school mathematics (through the child) and home mathematics (through the mother's knowledge). It also adds to our understanding of issues related to students' language choice when doing mathematics.

In his chapter, Dominguez underscores the need to develop spaces for parents to engage in dialogues about problem solving with other parents, with students, and with teachers. Working with a group of seven Latina mothers, Dominguez analyzes the dialogue of these mothers as they talk about their experiences with mathematics, reflect on their children's mathematics education, and suggest ideas for practice to one teacher. Using Belenky, Clinchey, Goldberger, and Tarule's (1986) framework for women's ways of knowing, Dominguez characterizes the dialogue of this group of mothers among themselves as representing primarily "silence" and "constructed knowledge." In their interactions with three students, Dominguez hints at a possible gender aspect in how the mothers interacted with male and female students, promoting more independent thinking in the boys while using a more prescriptive (reproduction of specific methods) with the girl. These findings are tentative given the small sample, but may be worth pursuing given their own experiences as women in mathematics. Their dialogue with the teacher points to a possible difference of opinion between the mothers and the teacher in that the mothers suggest ideas that could be used to enrich the mathematical learning in the classroom, while the teacher seems to indicate that not everything is learned in the classroom and appears to separate the two contexts (in and out of the classroom). Dominguez highlights the lack of appropriation of each other's (teacher-mothers) dialogue. As he writes, "the need for a dialogic interspace between parents and teachers has been identified and requires further research."

Acosta-Iriqui, Civil, Díez-Palomar, Marshall, and Quinto-Alonso discuss the impact of two different language policies on Latino/a parental engagement in mathematics education. While the New Mexico Constitution endorses bilingual education, Arizona severely restricted bilingual education in 2000 with the passing of Proposition 203 (based on Proposition 227 passed in 1998 in California). Both CEMELE sites (Albuquerque and Tucson) had parents' groups with whom the authors conducted in-depth interviews, focus groups, and mathematics classroom observations and debriefings. The chapter discusses the situated nature of parental engagement and then centers on the effects of the different language policies on the engagement of Spanish-dominant parents in their children's mathematics education. The findings reveal the crucial role of context within mathematics education, which includes the historicity of the communities and the impact of the different educational policies. Parents in both contexts are aware of the benefits and limitations that bilingual education or English-only policies create for them and their children. In particular, in the case of the Arizona parents, they express their frustration at not being able to feel as connected with their children's mathematics education (e.g., homework) as they wished due to the language barrier. While the New Mexico parents seemed optimistic about their children's educational future, some of the Arizona parents were concerned about the dropout risk for their children. Overall, parents were in favor of bilingual education as the way to keep the connection with the family's linguistic and cultural background. This chapter points to the need to consider the role of language policies in the mathematics education of Latino/a students.

Turner, Varley Gutierrez, and Díez-Palomar study students' experiences in an after-school mathematics club that focused on "mathematizing" activities in various local community settings (a donut shop/bakery, a custom auto shop that specialized in low riders, a store that sold candies and Pina-tas, and a neighborhood park that had recently burned down). A central notion in this chapter is community mathematization, which refers to the ways in which participants use mathematics to make sense of their worlds. The participants included 18 third- through sixth-grade Latino/a children, most of them bilingual English-Spanish. Working in small groups (facilitated by undergraduate research assistants and by CEMELE researchers), students analyzed the practices of each community setting with an eye on the mathematics in those practices. Students then posed an authentic problem that emerged from their understanding of the mathematical practices and developed a digital story to illustrate their learning. The chapter presents findings related to the students' mathematizing activity and to their problem-posing work. In particular they discuss the mathematization in the context of the auto shop setting. One of the practices involves enlarging a design. The authors illustrate how the children explored this topic through
Section on Latinos/as, Teacher Education, and Mathematics Education

Decades of research in educational reform have confirmed what should have always been obvious: teachers, what they know and what they do, are chief to any academic reform or enhancement (Darling-Hammond & McLaughlin, 1995). Therefore, any thoughtful effort to improve the mathematics achievement of Latinos must account for teachers’ knowledge and skills. This section of the volume shares three “thickly” described studies of teachers working to better understand their own practices and engage in those strategies and pedagogical stances that better serve Latino/a learners. These chapters on teaching help us to make sense of the complex connections between teacher knowledge, beliefs, and behavior and student performance.

In the research reported by Anhalt and Ondrus, we learn that teachers’ content knowledge grows when they are confronted with the prospect of teaching students who do not share their native language. Using algebra blocks to represent challenging mathematical concepts, the teachers in this study came to realize the power of multiple representations as a tool for promoting both complex thinking and mathematical conversations. This case study research underscores the power of the use of multiple representations in assisting mathematical understanding. While this finding has been corroborated many times in the research literature, Anhalt and Ondrus point out the importance of the teacher’s understanding of the value of multiple representations. Their candid assessment of the professional development program they developed offers all teacher educators several pieces of very good advice; specifically, the integration of mathematics, language, and pedagogy appears to have been a crucial piece of their work.

In the Musanti, Marshall, Ceballos, and Celedón-Pattichis chapter, we are able to follow the growing mathematical and linguistic knowledge and skills of both teacher and researchers, illustrating, once again, the power of collaboration in advancing pedagogical knowledge. The teacher’s own admission of her weakness in understanding mathematical concepts is shared openly. The researchers themselves admit to gaps in their practical understanding of Cognitively Guided Instruction (CGI). Together, however, their progress in creating a rich mathematical environment in a bilingual primary classroom—an educational context rarely explored in mathematics education—offers both researchers and educators a thoughtful way forward. Most important, perhaps, is the teacher’s report on the confidence and mathematics her students gained as a consequence of CGI, mathematics instruction in Spanish, and the reliance on their prior ambient understanding of mathematics (e.g., shopping at the Flea Market, selling tamales). This study therefore offers indisputable and practical evidence that working class Latino English learners can engage in complex mathematical understanding.

The research by Quinones, Civil, and Torres demonstrates that teaching in non-dominant communities requires a vision of social justice. By following the work of an expert teacher (Torres), this chapter underscores the importance of studying mathematics education from a critical and situated perspective that foregrounds the historical and socio-cultural, as well as demonstrating what a single teacher can do for her students even as the larger structural forces are weighed against critical engagement. Their study confirms that a deep knowledge of students’ identities is crucial for truly critical teaching. But the research also notes the time and dedication such knowledge requires. There is no shortcut when teachers take seriously the rights of students and their own capacity for meaning making.

Section on Latinos/as, Assessment, and Mathematics Education

Although the chapters in this section reflect perhaps a broader focus than the others, the issues surrounding assessment are crucial if we are to accurately measure progress in improving the achievement of Latinos/as in mathematics. As the country enters the second decade of the accountability era, tests and other assessments continue to be misused in the evaluation of Latinos/as, especially those who are EL. These chapters, taken together,
suggest new, thoughtful, and valid assessment practices at the classroom, school, and national level.

Castellón, Burr, and Kitchen use an interactive interview research protocol to assess Latino/a ELs’ knowledge of fractions. The idea behind the use of this interactive interview protocol is not only to assess ELs’ understanding of fractions but also to foster their understanding. This protocol promotes a focus on the resources that ELs bring to the discussion of problems, rather than a deficit approach. Their findings suggest that the interactive interview protocol created a supportive environment in which students’ language capacity would not determine their understanding of mathematical concepts and allowed students to explain their thinking using methods that also represent competent mathematical communication (Moschkovich, 2007a). In sum, this chapter contributes to the area of research on understanding of fractions, through an in-depth study with four middle-school EL students. Some of the examples from the data show how knowledge is socially constructed through the interviewing process. The interaction between each student and the two interviewers allowed for rich communication of mathematical ideas, beyond an emphasis on using only academic language, thus positioning the students as competent problem solvers.

The chapter by Solano-Flores reminds us that we must always be on the lookout for systematic bias in all tests and assessment. As Solano-Flores points out, cultural differences and limited proficiency in the language influence the performance of students on tests, and that testing practices for these students have not changed significantly. He points out in careful detail, that the complexity of language, the multiple linguistic features of mathematics test items, and the linguistic heterogeneity of EL populations, testing for Latino/a EL should be based on a deep and abiding understanding of the relationship between language variation and score variation. He also discusses the process of development large-scale assessment and examines the limitations of current practice in the testing of ELs that result from not properly incorporating a view of language as a process. This important chapter fills in some serious gaps in our knowledge of how ill-conceived testing schemes can work against the proper placement of Latino EL.

Next, Mosqueda’s work offers a compelling examination of several variables long discussed in the mathematics achievement of Latinos/as but rarely explored for their complex relationships. Using the 2002 Educational Longitudinal Study, Mosqueda explores whether academic tracking and math teachers’ content knowledge and teaching preparation influences the mathematics performance of Latino secondary students, both native and non-native English speakers. After analyzing the data using multilevel models, his analysis confirms that Latino ELs are indeed placed in lower track mathematics classes, a practice that appears to be based solely on English capacity and not on mathematical knowledge. Not surprisingly, this type of tracking results in lower performance for Latino ELs. The analysis also revealed some interesting findings regarding teacher qualifications: Having a teacher with a mathematics degree was associated with higher achievement whereas credential status was not. Mosqueda is cautious in interpreting this finding, but it nevertheless suggests additional study on the preparation of teachers for Latino EL mathematics learners is warranted. Most importantly, the study reveals that some of the patterns of underperformance by Latino ELs are a consequence of poor policy decisions often made at the local level, which, unlike large bureaucracies, can be easily modified.

**FINAL THOUGHTS**

We are confident that the research in this volume will inspire additional researchers to conduct investigations that will yield new practices and policies to improve the mathematics education of Latinos/as. But we would remind readers that research and its careful application takes time. Latino underperformance in mathematics, while an urgent issue, cannot be guided by panic. Researchers are beholden to a systematic process of discovery, a set of rules for the generalization of findings, and thoughtful guidelines for the application of research findings to the practice setting. Unfortunately, misguided accountability schemes, such as No Child Left Behind, encourage schools and school systems to seek the “quick fix,” employing untested curricula and methods not because they necessarily believe they will benefit students but rather to provide policymakers with evidence that they are doing something to improve test scores. By contrast, the chapters in this volume all demonstrate that improving the mathematics education of Latinos/as cannot be achieved with a simple curricular grafting or an afternoon of teacher “training.”

It is striking that any educator or educationalist might imagine that it is otherwise. After all, improving mathematics instruction for Latinos/as intersects at two of our most complex human systems: culture and language. And it is our hope that this book has served to complicate these two issues regarding the teaching and learning of mathematics, especially when we are considering students who represent a cultural group whose background differs from the vast majority of those in charge of the schooling system itself. We have chosen to explore Latino/a learners and teachers in U.S. schools and communities to examine these issues in great detail, and have thus selected studies that examined systematically the role of language, culture, or both for its influence on the mathematical experiences of Latinos/as, both in and out of school. We are confident that each chapt-
ter in this book provides evidence that mathematics educators who choose to ignore language or culture in their pedagogy risk shortchanging their Latino/a students.

REFERENCES


Latinos/as and Mathematics Education
Research on Learning and Teaching in Classrooms and Communities

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FOREWORD

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This volume is the result of several years of research on mathematics and education produced by the NSF-sponsored Center for the Mathematics Education of Latino Students (CEMELA). From its beginnings, as conceptualized by Marta Civil of The University of Arizona, the goal of CEMELA was to undertake research on this crucial research topic in a variety of social settings and conditions found in different regions of the country, and with a special focus on Latino students, given the great demographic growth of this population. The work thus required not only the collaboration of colleagues from four different universities, and of administrators, teachers, families and students at many schools, but also broad agreement on a general framework for the work that the group came to depict as a sociocultural approach.

The great challenge offered by any sociocultural approach is that of bringing to life the study of human learning and development. As Alexander Luria (1982) famously suggested, the key is to locate the study of human thinking not in the “recesses of the human brain or in the depths of the spirit” but “...in the external processes of social life, in the social and historical forms of human existence” (p. 25). This volume seeks to meet this challenge, and does so admirably, through a range of studies of mathematics and education situated in a variety of conditions for learning.