Understanding the Needs of Latino Students in Reform-Oriented Mathematics Classrooms

Judit N. Moschkovich

Curriculum guidelines and research in mathematics education have outlined the characteristics of reform-oriented mathematics classrooms (National Council of Teachers of Mathematics [NCTM] 1989). These characteristics include an increased emphasis on communication and collaborative work. It is important in designing classroom instruction for Latino students to consider how these two new emphases—a focus on mathematical discourse and new forms of student participation—might intersect with the needs of Latino students and affect their experiences in the mathematics classroom.

First, a clarification: The labels Latino, Hispanic, and Spanish-speaking may be useful as general descriptors for a population of students. However, these labels can obscure crucial distinctions, such as whether a student is a recent immigrant or a native of the United States (Ogbu 1991) and important differences, such as linguistic diversity in the use of Spanish and English (Garcia and Gonzalez 1995). For example, students labeled as Latino can differ in length of residence in the United States, language proficiency in English, language proficiency in Spanish, prior school experience, and socioeconomic status. Students labeled as Mexican Americans, the largest group of Latinos in the United States (Garcia and Gonzalez 1995), differ in where they were born—in the United States or in Mexico; where they live—in an urban or rural area; which languages they speak; their parents’ occupation, income, education, and languages; and how many generations their families have been in the United States (Sánchez 1983).

These differences mean that the needs of Latino students are both diverse and specific to individual students. Consider, for example, the following contrasting situations: A student who is a recent arrival, has missed three years of school in her home country, and is orally fluent in Spanish but not proficient in writing or reading will have very different needs in the mathematics classroom from those of a student who is a recent arrival, has not missed any school in her home country, and has completed a year of algebra in Spanish. These two students in turn have different needs from those of a student who immigrated to the United States several years ago, has some proficiency in Spanish, and has had only one or two years of mathematics classes in Spanish or from those of a student who was born in the United States and whose schooling experience has been entirely in English.

Within this diversity, Latino students still share some common needs with other “minority” students. As part of the minority student population, Latino students need access to curricula, instruction, and teachers that have proved to be effective in...
supporting the success of minority students. The general characteristics of such environments are that the curricula provide “abundant and diverse opportunities for speaking, listening, reading, and writing” and that instruction “encourage students to take risks, construct meaning, and seek reinterpretations of knowledge within compatible social contexts” (Garcia and Gonzalez 1995, p. 424).

Some of the characteristics of teachers who have been documented as being successful with minority students are (a) a high commitment to their students’ academic success and to student-home communication, (b) high expectations for all students, (c) the autonomy to change curriculum and instruction to meet the specific needs of their students, and (d) a rejection of models of their students as intellectually disadvantaged (Garcia and Gonzalez 1995).

Latino students who are English-language learners share academic and assessment needs with other non-Latino English-language learners. The following example illustrates the importance of considering whether students who are learning English are being placed in mathematics classrooms according to their proficiency in English or their proficiency in mathematics.

While observing a mainstream ninth-grade mathematics classroom, I noticed that two Spanish-dominant Latino students were not participating in the lesson on graphing parabolas. When I asked them (in Spanish) if they were having a problem, they told me they had already studied this material the previous year in their native country. They also said that they felt discouraged because in their view they were falling behind by repeating material they already knew. These two students, like other English-language learners in similar circumstances, might have benefited from a more accurate assessment of their academic knowledge that might lead to a more appropriate study program.

This example is not an isolated incident but reflects a common situation in which English-language learners receive differential treatment because of inappropriate assessment of their skills (Losey 1995). Placing students in mathematics classrooms solely on the basis of English proficiency can lead to the repetition of mathematics content that English-language learners may have already studied, and this repetition can lead to decreased engagement in classroom activities. For placement to be more effective, English-language learners should be assessed on a diversity of skills in a number of different contexts (Losey 1995). For example, written placement tests can be supplemented by other sources of information, such as interviews with the students.

A NEW EMPHASIS ON MATHEMATICAL DISCOURSE

Mathematics curriculum and teaching standards have come to reflect a model of mathematics learning that emphasizes discourse and communication (NCTM 1989). As mathematics classrooms shift from a focus on primarily silent and individual activities (Cazden 1986; Stodolsky 1988) to more verbal and social ones (Cobb, Wood, and Yackel 1993; Flores, Sowder, Philipp, and Schapelle 1996), Latino students are facing new challenges and developing new needs. In reform-oriented mathematics classrooms, students are no longer grappling mainly with acquiring technical vocabulary, developing comprehension skills to read and understand mathematics textbooks, or solving standard word problems. Instead, students are now expected to participate in both verbal and written mathematical discourse practices (Gee 1992), such as explaining solution processes, describing conjectures, proving conclusions, and presenting arguments.

This new emphasis on mathematical discourse will probably change the nature of all students’ experiences in the mathematics classroom by increasing oral activities and decreasing activities involving solitary text comprehension. However, it is not clear how this new emphasis might affect Latino students in particular or how classroom instruction can support the development of their mathematical discourse.
On the one hand, the increased expectation for Latino students who are English-language learners to participate in public conversations might increase the possibilities that these students will be assessed as deficient in mathematics because of their developing oral language skills. In contrast, prior to this new emphasis, English-language learners could have appeared more mathematically competent while they worked silently at their desks on a worksheet. On the other hand, this change might also provide more opportunities for English-language learners to participate in purposeful and contextual conversations with other speakers, creating an environment that can support both language and conceptual development.

Recommendations for mathematics instruction for English-language learners have contributed to teaching practices by describing how instruction can directly address interference between a student’s native language and English or between systems of representation in different countries, such as the different use of commas and periods to denote place value. However, many of the current guidelines for mathematics instruction for English-language learners give a limited view of learning mathematics and do not address the new emphasis on mathematical discourse. Instructional recommendations have tended to focus on English-language learners’ understanding of word problems, comprehension of written mathematical texts, or vocabulary development (Dale and Cuenas 1987; MacGregor and Moore 1992; Olivares 1996; Rubenstein 1996). However, since Latino students will be expected to discuss, argue, and communicate about mathematics (Brenner 1994), research studies now need to consider these new demands and document how they affect this student population.

A more comprehensive empirical research base is needed to guide the design of classroom mathematics instruction for Latino students who are learning English. Despite the steadily increasing population of American students, estimated to be five million, who are classified as limited in English proficiency (one million of these in California, a large percent of them Latinos), little research has addressed these students’ needs in mathematics classrooms. Although several studies have focused on the difficulties faced by Latino students in learning mathematics (Cuevas 1984; Cuevas, Mann, and McClung 1986; Mestre 1982, 1988; Mestre and Gerace 1982; Mestre, Gerace, and Lockhead 1982; Spanos, Rhodes, Dale, and Crandall 1988), these studies examined students solving traditional word problems, understanding individual vocabulary terms, or translating from English to mathematical symbols. It seems difficult to connect these findings about traditional word problems to the design of lessons in which students are expected to write and talk about their solutions to open-ended problems, present written or oral arguments for or against conjectures, and defend their conclusions about a mathematical situation.

Although several current studies have focused on discourse in monolingual mathematics and science classrooms (Cobb, Wood, and Yackel 1993; Lemke 1990; Pimm 1987; Pirie 1991; Richards 1991), researchers have only recently begun to consider conversations in language-minority classrooms (Brenner 1994; Khisty 1995; Khisty, McLeod, and Berrillo 1990; Rosebery, Warren, and Conant 1992; Thornburg and Karp 1992). This developing body of research reflects current models of learning and teaching mathematics, in which mathematical discourse is seen as an integral aspect of learning mathematics.

The design of teaching environments for this population of students would be facilitated by developing—

- a deeper understanding of classroom mathematical discourse in general;
- descriptions of how learning mathematics in two languages involves more than acquiring technical vocabulary or translating word problems;
- examples of the resources bilingual students bring to the mathematics classroom.

Research on student learning and recommendations for teaching mathematics to English-language learners that emphasize the obstacles Latino students face when learning mathematics risk presenting a deficiency model (Garcia and Gonzalez 1995; Gonzalez 1995) of these students. Instead, instruction in mathematical communication
needs to consider not only the obstacles students face but also the resources these students use to communicate mathematically.

Research is needed that describes the resources Latino students use in these new classroom situations. Investigations also need to consider aspects of mathematical discourse beyond vocabulary and text comprehension, such as the discourse practices for presenting mathematical conjectures and arguments. Only then can principled classroom recommendations be developed that address the actual needs of Latino students in reforming mathematics classrooms.

In general, as mathematics classroom activities require more oral communication, the needs of Latino students will vary depending on their previous experiences with school mathematical discourse in either English or Spanish and their proficiency in those languages. One important consideration is that a student's overall proficiency in one language does not necessarily reflect proficiency in mathematical discourse in that language. For example, a student may be proficient in nonmathematical English but not as proficient in mathematical discourse in English.

Students will also have different language proficiencies in different areas of mathematics. For example, some students who may be proficient in Spanish in one topic, such as percents, may not be proficient in Spanish in another context, such as algebra, because they have not had classroom experiences in Spanish in that subject.

Students will benefit from Spanish translations, written or oral, in various ways. For some, translations can support the understanding of the mathematics concepts, whereas for others, translations can support the development of language proficiency in Spanish. In general, if a student has studied mathematics in Spanish and is a proficient reader in that language, written translations of the material can be useful for developing mathematical concepts and building on the student's previous knowledge. For students who have had little or no experience in a mathematics classroom in Spanish, written translations of the materials will be useful in supporting the development of Spanish proficiency and literacy, but translations may not necessarily clarify the mathematics concepts.

An important consideration is that mathematical conversations involve much more than vocabulary (Halliday 1978; Pimm 1987). Thus, a student who may be less proficient in one language in the vocabulary of a specific topic in mathematics—for example, algebra—may be proficient in another aspect of mathematical discourse, such as presenting clear arguments. Although students may benefit from having access to mathematical vocabulary in Spanish, students use Spanish in mathematical conversations in ways that go beyond vocabulary (Moschkovich 1996a, 1996b).

Sometimes Latino students may present explanations first in one language and then in the other or use a combination of Spanish and English to construct an argument (Moschkovich 1996b). Frequently, these explanations reflect important conceptual knowledge that might not have been evident if the student had been limited to using only one language. Classroom activities can support conceptual development by allowing for flexible language use during mathematical conversations between students and in whole-class discussions.

NEW FORMS OF STUDENT PARTICIPATION

The NCTM Curriculum and Evaluation Standards for School Mathematics (the Standards) (1989) also calls for new forms of classroom participation. The Standards recommends a shift from teacher presentation and individual student seatwork to a diversity of forms for student participation in classroom activities. Students are expected to work in pairs or small groups, participate in whole-class discussions, and make presentations to the class. It is not clear how these proposed forms of student
participation will affect Latino students in particular, and no research studies have explored the impact of these new forms of participation.

Two important questions that research on student participation in mathematics classrooms will need to address are (1) how these new forms of participation do or do not reflect Latino students’ previous experiences in school or the participation structures (Au 1980) in their homes and (2) how these forms of participation affect Latino students’ academic achievement in mathematics.

Although research has described participation structures in the home cultures of other populations, such as native Hawaiian students (Au 1980) and Navaho students (Vogt, Jordan, and Tharp 1987) and how differences in participation structures affect classroom interactions, it is important to note that research specifically addressing the needs of Latino students does not provide a clear basis for generalizations. Even for Mexican Americans, the largest Latino subgroup, generalizations about culturally appropriate instruction do not follow easily from the results of research studies of home environments.

For example, a review of recent studies comparing Mexican American and Anglo home interactions (Losey 1995) found that these studies had not examined a natural setting, used a natural task, or described important differences such as participants’ income, social class, or education. Similarly, many of the studies comparing styles of interaction at school and at home had not fully examined each of these settings or considered differences in socioeconomic levels or ethnicity.

It is also difficult to make generalizations about cooperative learning. Although cooperative learning is thought to be appropriate for language minority children in general (Kagan 1986), this recommendation is based on psychological experiments rather than on classroom-based research relating cooperative learning in mathematics classrooms specifically to academic achievement for Latino students. Although studies of successful classroom environments for Mexican Americans conclude that collaborative learning, among other classroom characteristics, can “enhance classroom interaction, and ultimately, student success” (Losey 1995, p. 312), this claim is not yet supported by data on mathematics learning.

Moreover, because these studies usually focused on literacy and language development and did not address mathematics instruction or conceptual development in mathematics, it does not seem appropriate to go from these general suggestions to specific recommendations for organizing the participation of Latino students in mathematics classrooms. More empirical research is needed that explores these questions and that specifically relates mathematics instruction and forms of participation to students’ conceptual learning in mathematics.

Even though at this point it seems difficult to make generalizations about Latino students’ needs in reform-oriented mathematics classrooms, the following are some important considerations that can guide the design of mathematics instruction for these students: (1) honor the diversity of Latino students’ experiences, (2) know the students and their experiences, (3) avoid deficit models, and (4) provide opportunities for mathematical discussions.

Honor the Diversity of Latino Students’ Experiences

One reason to avoid generalizations about the needs of Latino students is that culture is a complex phenomenon. González (1995) decries approaches that “have relegated notions of culture to observable surface markers of folklore, assuming that all members of a particular group share a normative, bounded, and integrated view of their own
culture” (p. 237). She presents the view that we cannot assume cultural uniformity or a simple set of shared practices for any cultural group (González 1995, p. 237):

The households from which students emerge are intersected by multiple mediated constructs that can belie a harmonious and homogeneous set of cultural practices, and we cannot assume cultural uniformity as a canon of knowledge that simply has to be transmitted transgenerationally.

Latino students come from diverse cultural groups and have varied experiences. It is difficult to make recommendations about the needs of Latino students in mathematics classrooms that would accurately reflect the experiences of a student from a remote Andean village, a student from a bustling Latin American city, a student from a Southwest border town in the United States, and a student from an Afro-Caribbean island. Although these students will have some shared experiences, such as some relationship to the use of Spanish, there will also be many differences among these students’ experiences, either at home or in school. Both the differences and commonalities among Latino students should be kept in mind when designing mathematics instruction.

Know the Students

González goes on to suggest that “approaches to culture that take into account multiple perspectives can reorient educators to consider the everyday lived experiences of their students” (González 1995, p. 237). The best way to determine what are culturally appropriate classroom-participation structures is to get to know the students and their communities (González 1995; González et al. 1995; Moll et al. 1992). For example, decisions about the instructional needs of Latino students should be made on the basis of specific information about the students’ previous experiences in mathematics classrooms. It is important to talk explicitly with students about the ways in which they participated in previous mathematics classrooms and how those ways may be the same as, or different from, the ways in which they are expected to participate in their present classroom.

Avoid Deficit Models

Latino students have been characterized by a deficit model in which their failure in schools and on standardized tests is related to their culture and home environment (González 1995). Latino students share with other English-language learners an experience of instruction that has often focused on “language genres, behavior patterns, motivations, attitudes, and expectations that are either unacknowledged by the schools or seen as developmental deficits that must be remediated” or proscribed before learning can begin (Garcia and González 1995, p. 422).

In designing mathematics instruction for Latino students, we need to move from deficit models of these students to frameworks that value the resources that they bring to the mathematics classroom. Recent work provides examples of frameworks for viewing Latino students or their households as the source of cognitive and social resources rather than as the source of obstacles and deficiencies (González 1995; González et al. 1995; Moll et al. 1992; Moschkovich 1996b).

Provide Opportunities for Mathematical Discussions

The new emphasis on mathematical discourse and the new forms of student participation point to the need for Latino students to have the opportunity to engage in mathematical discussions with their peers, with their teacher, and with their whole class. Mathematical discussions can be defined as “purposeful talk on a mathematical subject in which there are genuine pupil contributions and interactions” (Pirie 1991, p. 143).

Students need opportunities to use the language of mathematics not only to read textbooks, translate algebra word problems into equations, or carry out computations but also to pose mathematical questions, describe the solutions to problems, explain and justify their solutions, present arguments for or against conjectures, and defend their generalizations.
References


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