

Issues of Language:

Teacher Insights from Mathematics Lessons in Chinese

A fundamental concern in mathematics education is to understand the connection between the mathematics and the students who are trying to learn the mathematics. Even under ordinary conditions, it may be difficult for teachers to completely understand the challenges that students face. This can be especially true for teachers of English language learners (ELL).

Given the steadily increasing population of U.S. students who are classified as limited in English proficiency, it is imperative that teachers understand the perspective of an ELL student in an English-speaking classroom. Meaningful professional development can further this type of understanding. In this article, we describe a professional development experience

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in which twenty-two teachers from schools with large Latino student populations participated in two mathematics lessons taught in Chinese. The goal for the activity was to allow the teachers to experience challenges similar to those that many students face. Thus, in addition to describing the mathematics lessons, we examine some of the participating teachers' reflections and insights.

The participants were enrolled in a mathematics course for middle school teachers. The course was offered by the Center for the Mathematics Education of Latinos/as (CEMELA) as a component of a professional development strand



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for middle school teachers. A goal of the course was to broaden and deepen practicing teachers' knowledge of the mathematics they teach while helping them address the roles of language in the teaching and learning of mathematics. On average, the teachers are from schools with student populations of approximately 82 percent Latino, 7 percent Native American, 3 percent African American, 7 percent White, and 1 percent Asian. Approximately 32 percent of each school's student population is identified as ELL, and the majority of the Latino families whose students attend these schools are middle to lower working class.

RESEARCH COMMENTS

A challenge for mathematics educators is to understand and use the linguistic strengths and experiences that students bring to school. "A major characteristic of the majority of Latino children is their affiliation with Spanish regardless of their proficiency in that language. Even a child who may not seem to be proficient in speaking Spanish may come from a home or community in which Spanish is spoken extensively. Thus, the child's environment is bilingual, which has a profound influence on his or her experiences, perceptions, and knowledge base" (Khisty 2002, p. 32). In short, some Latino students may not be classified as ELL, but they nevertheless have cultural experiences from which mathematics educators can draw to inform the creation of effective learning experiences.

Reform-oriented classrooms can be linguistically demanding because students are expected to explain solutions, make and describe conjectures, justify conclusions, and present arguments (NCTM 2000). Moschkovich (1999) suggests that the increased expectations for all students to participate in public conversations might increase the opportunities for Latino students who are ELL to participate in purposeful and contextual mathematical conversations, thus creating an environment that can support both language and conceptual development. This type of interaction is at the heart of learning meaning in mathematics through a process that is socially and culturally mediated (Khisty 2002). She argues that cognitive development in mathematics is very much a language-based activity, and that one important model of academic language and its meaning in the mathematics classroom is the teacher.

A growing body of literature in second-language acquisition and mathematics learning and teaching attempts to not only explain the phe-

nomenon of learning mathematics in a second language but to uncover the role of language and its development as mathematics learning occurs. Crandall, Dale, Rhodes, and Spanos (1985, p. 130) discuss the role of language:

The role of language is ubiquitous. It is the medium by which teachers introduce and convey concepts and procedures, through which texts and problems are read and solved, and by which math achievement is measured. Language skills—particularly the reading skills needed to comprehend mathematics texts and word problems and the listening skills required to understand and

I'll speak to new foreign students, but I won't expect or force a response

follow an instructor's presentation of a problem's solution—are the vehicles through which students learn and apply math concepts and skills.

THE PROFESSIONAL DEVELOPMENT EXPERIENCE

Dale and Cuevas (1992) discuss ways to give teachers a working knowledge of teaching mathematics to second language learners and the strategies and techniques to make teaching effective. In their work, they emphasize that mathematics is a language and has its own vocabulary, sentence structure, semantic properties, and discourse features. Dale and Cuevas (1992) also assert that language is the vehicle of learning and instruction and that language works as a mediator for mathematical thinking. Thus, mathematical thinking, mediated by

linguistic processes, is a prerequisite for mathematics achievement. With these points in mind, they suggest that instruction should promote English language development through a natural process in which the focus is not on language only but on communicating the concepts, processes, and applications of mathematics (see, also, Echevarria, Vogt, and Short 2004).

Planning for the lessons on area and perimeter

The insights provided in the aforementioned literature guided the development of the experience we wanted to provide for the middle school teachers. The goals for the two lessons in Chinese were for teachers to (1) uncover insights into possible students' feelings and thinking when they are learning mathematics in a second language; (2) be reflective practitioners regarding issues relevant to teaching mathematics to Latino students who may be learning English while learning mathematics; and (3) re-examine strategies in teaching ELL students with respect to their gained experience with the mathematics lessons in Chinese, such as the use of concrete manipulatives and the extent to which the strategies allow students the opportunities to understand mathematics concepts and learn English simultaneously. In preparation for the lessons, a group of two mathematicians and two mathematics educators discussed various pedagogical options. We agreed that the first lesson would be taught in a traditional lecture format and the second in a way that included more visual and concrete representations of area and perimeter, including the use of deliberate hand gestures. In addition, we planned for the participating teachers to use the same manipulatives (geoboards and color tiles) as the instructor during the second lesson. Although the instructor was not fully familiar with shel-

tered English instruction (SEI), we nevertheless planned for the second lesson to consist of more representations, examples, and illustrations. [SEI is an instructional approach using clear, direct, and simple English with scaffolding strategies.—Ed.] The second lesson differed from the first lesson, but the delivery was still teacher-centered. We felt it was important that the second version of the lesson be conducted in a way that fit the instructor's comfort zone and experiences as a teacher.

The lessons

The lessons in Chinese were taught during the latter part of the semester, after the teachers had become familiar with one another, were comfortable having discussions about mathematics and pedagogy, and were open to reflecting on readings and classroom experiences. We began the class by introducing "the guest teacher," a visiting professor in the department of mathematics. The teachers in the class had never met her nor did they know that she would speak in Chinese throughout the lessons. Although the guest instructor does not specialize in mathematics education, she is regarded by students and colleagues as a highly effective teacher in the department of mathematics.

The focus of the lessons was to examine the area and perimeter of rectangles. The first lesson was primarily a lecture in which the instructor spoke in Chinese and wrote on the board at the front of the room. The writing on the board included drawings of rectangles, familiar Arabic numerals, and many Chinese characters. Although most of the writing was in Chinese, the letters A and P were used to represent area and perimeter (see **fig. 1**). Next to a 4×8 rectangle, for example, the instructor wrote " $A = 4 \times 8 = 32$ " and " $P = 2(4 + 8)$." She continued the lesson in this manner, reiterating how to find the perimeter and area of vari-

Fig. 1 The instructor used the letters A and P , Arabic numbers, and Chinese characters in her instruction.



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ous rectangles. Toward the end of this lesson, she drew a chart on the board whose headings were in Chinese; the entries across the rows were the numbers corresponding to the length, width, perimeter, and area of each rectangle used as an example.

After a few moments of silence following the completion of the first lesson, one teacher asked if there were specific words for area and perimeter, if A and P were used to denote area and perimeter, and if Arabic numerals were used in Chinese classrooms. The guest instructor replied affirmatively to all these questions. Following the first lesson, a teacher commented, "I noticed that the only reason I was able to follow was because of my background knowledge of area and perimeter. I knew what those were, and I was trying to figure out what it would be like for a student who had not been introduced to area and perimeter." This led another teacher to comment, "But if [the lesson was] about the relationships between area and perimeter, that went over my head. I was trying to concentrate on the numbers, your drawings, and your table, and I was trying to figure out a few of the [Chinese] characters but anything other than that was beyond my comprehension." A final comment was made by yet another teacher regarding the purpose for their participation in

this lesson, “Is it the same principle as us sitting here? The students who are ELL, they pick up the A and the P and the numbers, but not much else? He [pointing to a teacher] has to go through it in Spanish to get them [the ELL students] to get the flow of the concept. It’s no different than us listening to her [the guest instructor] as they [the ELL students] are to us.” Although most can imagine what it must feel like to listen and try to learn mathematics in a different language other than what we speak, we surmise that having firsthand experience provides unique insights for teachers. After these comments were made, the discussion was put on hold until after the presentation of the second lesson.

The second lesson included more representations of area and perimeter than the first lesson. It began with the instructor writing Chinese characters on the board, again conducting the lesson solely in Chinese. Shortly thereafter, she gave each member of the class a geoboard and began using an overhead projector to display the image of a geoboard on a screen at the front of the room. At this point, she began to construct examples of rectangles on the geoboard. With each example, she slowly counted the squares inside the rectangle, pointing to each square as she counted it. If, for example, she counted 12 squares, she wrote “ $A = 12$ ” on the board. She did the same for the perimeter of each rectangle. After four examples, the instructor put away the geoboard and began constructing examples of rectangles using 1-inch color tiles. Again, she carefully counted the area and perimeter of each rectangle and wrote the results on the board in the form “ $A = 12$ ” and “ $P = 14$.”

TEACHER OBSERVATIONS AND INSIGHTS

At the end of the second lesson, the guest instructor explained in English

that she had never before taught a lesson in Chinese to non-Chinese-speaking students and that she now appreciated the challenges associated with teaching a group of students who do not speak the language of instruction. The guest instructor’s perspective is critical in that it illustrates the universal challenge of teaching mathematics in a language different from the students’ language.

When asked to make comparisons between the two lessons and about what they understood from the lessons, one teacher responded that she was only paying attention to the words in Chinese, not the mathematics. She wanted to learn the numeral words in Chinese and paid little attention to the fact that the lesson was about area and perimeter. Another teacher mentioned that nothing made sense in Chinese except for the written numerals, so she wondered if that is how her ELL students feel when she is teaching. She also stated that she felt if she slowed down while teaching to point to things as she was explaining them, she would never get through the content. Another teacher wondered how one can spend time helping the ELL students while meeting the needs of fluent English speakers. In response, a different participant pointed out that teaching with more visual aids and manipulatives could accommodate most students while specifically meeting the instructional needs of ELL students. She reminded the class that this discussion occurred in a reading assignment earlier in the semester. This particular reading recommended constructing the mathematical concept with supportive strategies, such as visual aids and concrete manipulatives, then teaching the supporting English terms (Garrison and Mora 1999). For these teachers, participating in these lessons seemed at some level to bridge the gap between the theoretical aspects of the reading assignments

Nothing made sense in Chinese except for the written numerals; is this how ELL students feel?

and everyday teaching. A teacher then commented that if the students were learning a new concept and a new language simultaneously, then the visual cues and the concrete manipulatives could really be of value. He also indicated that he usually did not teach with manipulatives but now he would like to start.

One member of the class revealed that he ignored the language and focused on the mathematics that he understood. He mentioned that he knew the lesson was about area and perimeter but did not understand that the instructor was asking them to find the smallest perimeter with the same area. He did not feel that he could



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learn from a lesson in another language beyond what he already knew about area and perimeter. Another teacher agreed that she did not understand that the instructor was trying to show them that if the perimeter changes, the area can stay the same. She commented that near the end of the second lesson, she made a connection when the instructor assembled the color tiles into a 2×6 rectangle, counted the perimeter, and wrote $P = 16$ and $A = 12$; rearranged the tiles into a 1×12 rectangle, counted the perimeter, and wrote $P = 26$ and $A = 12$; and finally rearranged the tiles into a 3×4 rectangle, counted the perimeter, and wrote $P = 14$ and $A = 12$. She said that when the perimeter and area were pointed out in this way with tiles, she understood the point of the lesson but not necessarily that she needed to find the smallest perimeter.

A different teacher made a comment that if some of her peers who understood the lesson could have helped her early on in English (her first language), then she possibly could have made the connection between perimeter and area. She stated that “the grouping of students is really important; the teacher can allow for

students to tell each other what is going on in their first language.” Further discussion resulted in a comment from a teacher who had taken foundation courses in bilingual education:

As far as survival mode, I would hope that the teacher would allow me to stay in my silent period for at least six months [if I were a Chinese language learning student]. Because as a student who doesn't know the language, if she were to start asking me questions on the first day, or the first week, or the first month, I think that at that point, I would be so alarmed and so trying to learn the language as much as I could that I wouldn't even be paying attention to what the actual lesson was. Thanks to this experience, I mean I've read it, and hopefully I'll remember it, and now I think I'll remember it more rapidly, if I do get brand-new foreign students, . . . I don't want to force them to speak. I'll speak to them but I won't expect or force a response.

The experience evidently served as a realistic situation for this teacher, and she made connections between this class and her past theoretical readings on second-language acquisition.

Finally, a very insightful comment was made by a teacher regarding placement policies of students in mathematics classes, based on their English language proficiencies. She commented that during the Chinese lesson, she completely ignored the language because she understood the mathematics content being taught. She knew that the instructor was guiding them to see that the perimeter can change without changing the area. She stated that she knew of cases at her school in which ELL students who could work at a higher level of mathematics were placed in a lower-level mathematics class because of their limited English language

proficiency. The thinking behind this placement policy is that the students will learn English through the mathematics content they already know. She pointed out that based on her experience during the Chinese lessons, these students could very possibly be ignoring the English language completely during instruction, just as she ignored the Chinese language. Further, she pointed out that the students might be bored because the lower-level mathematics was too easy for them. She wondered if placements like these are common in other schools and if school systems are doing students a disservice in both their English language development and mathematics learning. This sentiment is supported by Moschkovich (1999), who states that a downfall of this situation is that Latino students may be assessed as deficient in mathematics because of their developing oral language skills in English. This can result in placements in which students are repeating familiar mathematics content, leading to decreased engagement in classroom activities and discourse.

In reflecting on all the issues that came up following these lessons, we realize how critical it is to allow open-ended discussions so that teachers can make realizations related to policies and issues typically not covered in courses that focus on content, curriculum, or pedagogy. The mathematics lessons taught in Chinese served as a context for many interesting discussions on policy, teacher education outside of the United States, politics, bilingual education, and so on that were discussed during this and subsequent class sessions. Just as important, the lesson placed the teachers as learners of mathematics in a language not known to them, which gave them a new perspective and understanding of how ELL students may feel while participating in a mathematics lesson taught in English with little

or no support. The teachers showed appreciation for pedagogical strategies advocated by such a philosophy as sheltered English instruction when the students' first language is not available to them.

CLOSING REMARKS

In a professional development class such as this, we feel it would be ineffective to simply prescribe how teachers should teach in classrooms with a large number of Latino students who are ELL students. We believe that the firsthand experience that teachers had in their participation in these lessons was meaningful in that they discovered insights into possible students' feelings and thinking when they are learning mathematics in a second language. This activity led to renewed perspectives by teachers regarding policies and how students are placed in mathematics classrooms because of their English language proficiency. For one teacher in particular, the issue of ignoring language and focusing on whatever mathematics she understood became much more tangible after this experience. This comment led all the teachers to consider their previous learning regarding strategies in teaching ELL students and the extent to which the strategies allow the students both to understand mathematics concepts *and* to learn English. We conclude by emphasizing the importance of continuing to encourage teachers to be reflective practitioners regarding issues relevant to teaching mathematics to Latino students who may be learning English while learning mathematics.

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(For more information about the learning and teaching of diverse populations, see the Changing Faces series at www.nctm.org.—Ed.) ●