OUT OF THE BOX

The Culturally Responsive Mathematics Classroom

By Tim Whiteford

"I just can't work out how Anna does these subtraction problems," thinks Mary, an elementary school teacher. "She puts a little 1 here and another little 1 down here, and she gets the right answer every time, even when I give her a four-digit number subtracted from a five-digit number. I've never seen anything like it."

There are few things more perplexing for an elementary school teacher during math class than a student who consistently gets a problem correct using a procedure that is completely incomprehensible.

Mary's difficulty in trying to understand Anna's procedures lies in the fact that Anna learned to subtract in Bosnia using the equal addition method of subtraction as opposed to the decomposition method currently used in U.S. classrooms. In the equal addition method, ten 1s are added to the top number and one 10 is added to the bottom number, as in the following:

$6^{1}4$	ten 1s are added to the 4 to make 14
$-\underline{2^{1}8}$	one 10 is added to the two 10s to make 30
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The problem is solved by saying "8 from 4 you can't; borrow 1 and pay it back." The "borrowed" 1 is placed next to the 4 to make 14, and the "paid back" 1 is placed next to the 2 in the 10's place to make three 10s. This method involves regrouping 64 as 50 + 14 in the above example.

Mary's dilemma is whether to get Anna to change the way she does her math, a question that should be asked each time a student brings his or her own math into a U.S. classroom.

Gay (2000) defines culturally responsive teaching as using the cultural knowledge, prior experience, and performance styles of diverse students to make learning more appropriate and effective for them. It means teaching to and through the strengths of these students.

Students entering U.S. classrooms from other cultures bring math that can be very different from the math they are expected to learn. They may have learned math using a different number base, certainly will have learned to count using different number names, and may have learned mathematical procedures that are markedly different from those taught in the United States.

They may also have learned math in classrooms that stressed rote learning at the expense of understanding, and they will most certainly have grown up experiencing the importance of numbers other than those that define U.S. culture: 50 (states), 9 (innings in a baseball game), 13 (original colonies), and so on. The number 3, for example, is of great significance in the Bosnian culture (the Muslim, Serbian, and Croatian cultures), and 26 + 6 holds special meaning in Ireland (the 26 counties of the Republic of Ireland and the 6 counties of Northern Ireland—a divided Ireland).

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Get to Know Students' "First" Mathematics

Mathematics is not the same the world over, especially in countries less affected by advances in technology. Some less industrialized cultures, such as those found in the Amazon basin, have no counting system at all and simply rely on the equivalent of three quantitative words for *one, two,* and *many.* In some African cultures there is no written form of the counting words (Ascher, 1994), and there are African countries that use counting systems using Base 5, 10, 12, or 20 or a composite of several bases.

Gesture counting using specific hand and finger referents is also extremely important in many African cultures (Zaslavbsky, 1993). The use of gesture counting means that traders from different cultures who speak different languages can reach agreement on prices for goods without the need for any form of oral language communication.

In cultures that, like the United States, use the Base 10 system, the words used to identify certain quantities can be much easier to learn than the complexities of counting in English caused by the words *eleven* and *twelve* as well as the words for the teen numbers. The May May language of the Somali Bantu people has, like many Asian languages, the simplicity of *tum-*

mung i kow (10 and 1) for 11, *tummung i lammih* (10 and 2) for 12, and so on all the way to 20. Other cultures also don't have the confusing similarities between the teen and decade names, such as the homophonic *fifteen* and *fifty*, that are made even more difficult for speakers of certain languages who lack experience pronouncing the *n* phoneme at the end of a word.

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Get to Know Students' Mathematical Procedures

One way of thinking about mathematical knowledge is to divide it into two parts: conceptual knowledge and procedural knowledge (Hiebert, 1986). Conceptual knowledge—the knowledge of ideas, concepts, and the relationships that exist between them—tends to be universal. Procedural knowledge—the knowledge of the symbols and procedures used to communicate ideas and perform computations—is "man made," arbitrary, and subject to a variety of technological, social, cultural, and environmental influences that can produce infinite variations. It is in the area of procedural knowledge where the greatest variation in mathematics can occur between different cultures.

Get to Know Students' Cultural Math

Number and quantitative relationships are not only a significant component of a culture but, in many cases, have a strong influence on the nature of that culture. The way people quantify the world through the selection of different referents when counting or measuring has a profound effect on the creation of meaning and the construction of cultural identity. Culturally responsive teaching is a pedagogy that recognizes the importance of including students' cultural references in all aspects of learning (Brown University, 2006).

The abandonment of the change to the metric system in the United States probably had more to do with the preservation of cultural identity than any practical difficulties that might have been caused by changing to the metric system. Everything people do in their lives is characterized in some way by the use of numbers, quantities, shapes, dimensions, and the language associated with such mathematical phenomena.

Sometimes, people use *naked numbers* with no referent attached and yet still manage to convey precise meaning. *Five-ninety-nine, two-thirty, deep six, lower forty,* and *hitting three-seventy-five* all convey meaning within appropriate contexts, even though no referent is present. A referent is the "oneness" of a particular number. In *five-ninety-nine* the referent for the 5 is dollars and for the 99, cents. But what about "It used to cost three and six" or "He was three for one-twenty-five at the close of play"? Both are meaningless to anyone who neither grew up in the United Kingdom in the days before decimal currency nor ever experienced the game of cricket. (*Three and six* is 3 shillings and 6 pennies; *three for one-twenty-five* is 3 wickets for 125 runs). So much of the meaning in the numbers people use is implicit and contextually defined in the sense that it is not overtly identified.

Get to Know How Students Were Taught Math

Several years ago, on a crisp fall morning in an inner-city classroom in Vermont, I was helping a teacher introduce a group of 20 K–6 Somali Bantu students to the world of the Base 10 counting number names (*one* through *twenty*). We used Unifix cubes to help the students associate the amounts with the number names for 1–10.

But first we wanted the students to get to know the cubes in terms of how they worked, their colors, and what they felt like. We told the students they could play with the cubes for the next 10 minutes and make anything they wanted. Within 5 minutes all 20 students were running around the room "firing" and "shooting at" each other with their Unifix "guns." We brought the students together and told them that they were not allowed to play with "guns" in U.S. classrooms and that they should make something else. This time, within 5 minutes every student was busily talking on a Unifix "cell phone."

In retrospect, I guess we didn't give much thought to what the students would make with the cubes; we probably just assumed they would make the same houses, cars, and shapes that most American elementary school children make when first introduced to this useful instructional material. The Bantu students made what were probably the only sharp, angular objects they had ever experienced in their lives in the camps in Somalia.

It is most likely that even if they had received any formal schooling there, they would not have experienced manipulative materials of the type used to teach math in most U.S. classrooms.

Very few elementary school classrooms in many Eastern European, Asian, and African countries use manipulative materials for teaching math. For the most part, math is taught procedurally, with little time given to the development of students' understanding of what they are learning. Recitation and memorization are the predominant forms of learning.

Get to Know Students' Mathematical Understanding

Recently, a third-grade teacher at a local school shared her concern about a student newly arrived from the Congo. The teacher thought that the student struggled during math class because she could barely speak any English. I agreed to interview the student to assess her level of math and prescribe some activities that would help her. I enlisted the help of the French-speaking Learning Center coordinator, who translated my questions and the student's responses. At the conclusion of the 20-minute interview, it was clear that it was not the student's lack of English that was causing her poor performance in math but her underdeveloped math skills. She couldn't count past 8 in either English or French.

Using an interpreter to understand a student's mathematical thinking only works if the interpreter communicates precisely and exactly the meanings conveyed by the student, including the use of any metaphor or *teacher patter* (Pimm, 1987) the student may have picked up along the way. Math education is full of metaphors such as *reducing fractions* (1/4 is not smaller than 4/8) and *the face of a clock*, and teacher patter such as *4 from 3 you can't* probably exists in all languages. Teachers in the United States need to understand the mathematical linguistic register (Halliday, 1975) that students bring with them from other cultures.

When differences between the math students bring with them and the math they are expected to learn in U.S. classrooms present themselves, we as teachers must decide whether it is in the students' best interest to continue using their "first" math. Above all, however, we must honor, validate, and respect students' math as we would their first language and culture.

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