Creating Cultural Relevance in Teaching and Learning Mathematics

Jacqueline Leonard and Smita Guha

Current reform in mathematics education, spurred by the National Council of Teachers of Mathematics (NCTM), emphasizes the importance of making connections to the real-world experiences of children. Even in such activities as riding a bus, subway train, or bicycle to school, the cultural experiences of children from diverse backgrounds provide teachers and students with a plethora of mathematics problems. Culture is meaning that is shared by a group of people who hold common values and beliefs (Malloy and Malloy 1998). Members of the group may have racial, ethnic, political, or community ties, which can be used as springboards for culturally relevant teaching.

Culturally relevant teaching is described as "a pedagogy that empowers students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes" (Ladson-Billings 1994, pp. 17–18). Culturally relevant teaching embeds student culture into the curriculum to maintain that culture and to transcend negative effects of the dominant culture. Such teachings also draw on the history of students' lives, as well as their unique ways of communicating, behaving, and knowing, while preparing students to effect change in society, not merely to fit into it (Ladson-Billings 1994). Thus, mathematics may be used to empower people to make needed changes both politically and economically (Moses and Cobb 2001). Mathematics problems that tap the culture of the students have the potential to engage them at each of these levels. The purpose of this article is to present examples of culturally relevant mathematics teaching.

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Why Pay Attention to Culture?

Teachers of children in early childhood programs and elementary school are more likely to be white, female, and middle class (Delpit 1988) and, thus, outside the culture of students of color and those who live in rural or urban areas. Some of these "mainstream" teachers may view the students' cultures and experiences as deficits (Malloy and Malloy 1998), not understanding the richness of the diversity students bring to the classroom. This cultural discontinuity creates a mismatch between the cultures of the home and school and may result in poor academic performance because teachers and students approach learning from different perspectives (Diller 1999). Including aspects of the students' culture in mathematics problems is one way

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to avoid the cultural deficit model and help students and teachers value the culture of the community.

Connecting Mathematics and Culture

Framing problems in a cultural context exposes students to problem solving from many perspectives. Barta and Schaelling (1998) suggest using cultural games to engage Native American students. Games can be used to motivate students of all cultures and backgrounds. Boykin and Toms (1985) suggest that teachers use such cultural expressions as rhythm, communalism, social-time perspective, verve, and movement to engage African American students.

Although ideas for teaching facts, rules, and algorithms may be abundant, engaging students in successful problem solving remains a daunting task. Students often are confused about which operation to use to solve word problems because they do not understand whether quantities in the problems are increasing or decreasing. Rosa and Minaya-Rowe (1999) used contextualized word problems to help Hispanic students improve their abilities to describe, explain, and justify mathematical understanding.

Using culture as the context to support mathematical understanding requires that teachers learn the culture of the community. Diller (1999) sought advice from a friend who was a member of the cultural community of the students she taught. Teachers also should become familiar with various pedagogical techniques, such as audience participation, choral response, and movement (Hollins, Smiler, and Spencer 1994), as well as different teaching strategies that have been successful with minority students, such as small-group and cooperative-group learning (Campbell 1994). Moreover, teachers should be aware of the presence and uses of mathematics in the students' communities.

Using Photography as a Basis for Problem Solving

As part of her mathematics program at a northeastern university, Jacqueline Leonard, one of the authors, showed a videotape series called *Good Morning Miss Toliver* (Toliver 1993a and b) to undergraduate education majors. In one videotape, Miss Toliver took her students on a walk in their neighborhood. As they walked, they photographed statues and other interesting artifacts in New York City. Miss Toliver later used these photographs to develop problems for her students to solve. This activity is culturally relevant because it empowers the students by giving them control of the task; challenges their intellectual, social, and emotional skills; and embeds the mathematics in a cultural context that matters to them (Ladson-Billings 1994).

FIGURE 1

Mack's problem about church services

Problem: On Sunday the service started at 10:45 A.M. At 12 noon on Wednesday is the Hour of Power service. How many days, hours, and minutes is it from Sunday service to Hour of Power?
Solution: 3 days, 1 hour, and 15 minutes

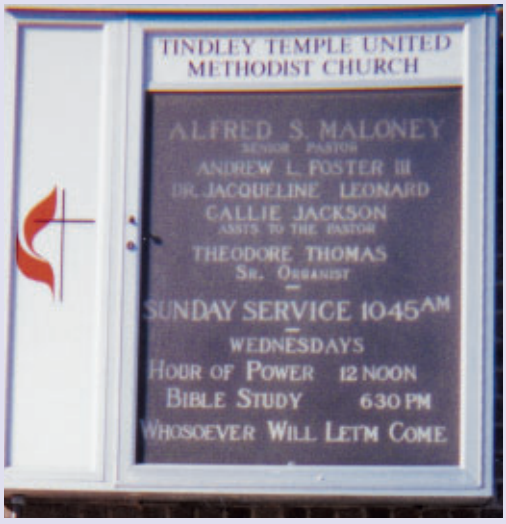

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FIGURE 2

Tracy's grocery problem

Problem: On Saturday Mrs. Hood brought in 2 bags of groceries. There are more groceries in one bag than in another. There are less than 17 [items] in one bag and more than 13 [items] in the other. If the total number of grocery items is 30, how many items are in each bag?
Solution: Answers may vary.

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We decided to use Toliver's idea with a small group of African American children in grades 2–5 who were enrolled in a Saturday school science and mathematics program at a downtown church in Philadelphia. One Saturday morning during the winter, the students and two adults took a walking tour of the children's neighborhood around the church, which served as the context for developing word problems. The students were given disposable cameras to take pictures of interesting sites and people, and the children were told that they would use the photos to write word problems. The next week, we gave the students their pictures and asked them to select two or three of the photographs to create problems.

Before letting the children work on the problems, Jacqueline shared slides of some pictures she had taken in Maryland. One of the photographs was of the aquarium in downtown Baltimore. The design of the building includes many different shapes. The students were asked to identify all the shapes they saw. Then, one of the pictures taken from the neighborhood walk was shown to the children. They were asked to brainstorm about all the mathematics they saw in the photograph. Initially, the children had difficulty seeing beyond the photograph to find the mathematics. We suggested that they think about the informative or geometric aspects of the pictures because many of them took photos of people, signs, historical markers, and interesting architecture.

The students were highly motivated by this task and immediately began to talk about the pictures and share their ideas. They used mathematics in new ways because they had to tap their visual and perceptual skills to see the mathematics in the pictures they took. The students also had to have some prerequisite skills in problem solving, such as knowing which elements are needed to develop a good problem. Because this group of children was small, we sat down with each child individually and listened as he or she created problems. Classroom teachers can use this technique by pairing students and emphasizing the writing process. We found that the writing process for developing word problems included the following steps: (1) brainstorming for ideas; (2) writing the problem; (3) checking the problem for context, needed information, quantities to solve, and a question to answer; and (4) revising the problem.

Four of the photos that were taken on the walking tour, along with the students' corresponding problems and solutions, are shown in **figures 1–4.** In addition to the results of the activity, analyzing the thinking processes of the students as they learned what was needed to develop good word problems is also important. The following exam-

ples were selected because the students struggled to make the problems interesting and challenging. Moreover, these problems incorporated the students' cultural experiences and motivated the children to "do" mathematics. Although some problems are placed only in a cultural context, others involve community problems or issues. Mack's problem deals with the church and its ministry to the community, and Tracy's problem involves food brought to the church to share with neighbors.

Mack's problem

Mack, a fifth grader, wrote the following problem about the church marquee (see **fig. 1**): "On Sunday the service started at 10:45 A.M. At 12 noon is the Hour of Power service. How long is Sunday morning service?" Initially, this problem appears to be adequate, but the Hour of Power service starts on Wednesday, not Sunday. When this fact was mentioned to Mack, he revised his thinking and wrote the following problem: "On Sunday the service started at 10:45 A.M. At 12 noon on Wednesday is the Hour of Power service. How many days, hours, and minutes is it from Sunday service to Hour of Power?" Mack came to the solution of 3 days, 1 hour, and 15 minutes entirely on his own. When asked to explain, Mack said, "How many days and hours from 10:45 A.M. to 12 noon? From Sunday to Wednesday is 3 days. It can't be 2 hours because that would be 12:45. So I figure 1 hour and how long . . . 45 to 60 is 15 minutes."

Mack could have changed the second part of his problem to answer the original question about the length of Sunday service, which deals with a real event. He created a more challenging and, perhaps, contrived problem, however, when the validity of his original idea was questioned. His choice reminds us that teachers must be careful when assisting students. We must allow students to keep the real-world focus of problems while making them more aware of the mathematics needed to solve them. In this situation, asking Mack to create more than one question about the times of the services shown in the photograph may have provided a bank of questions from which to choose. Then Mack could have selected one or two questions that were still "real" but required mathematics to obtain solutions.

Tracy's problem

Two parishioners are shown in **figure 2.** One of the parishioners has two shopping bags in her hands. Tracy, a third grader, created the following problem about this photograph: "On Saturday Mrs. Hood brought in 2 bags of groceries. There are more groceries in one bag than in another. If the total number of grocery items is 30, how many items are in each bag?" Jacqueline was concerned that this problem was too divergent and questioned Tracy about her intent. Tracy revised the problem in this way: "There are less than 17 [items] in one bag and more than 13 [items] in the other." This problem is good because it has multiple solutions. As long as the sum of the items equals 30 and one bag has more items than the other, the answer is correct. Tracy solved the problem by stating that one bag had 16 items and the other, 14. However, the original problem was even more open-ended and would have worked just as well. Again, teachers should be careful not to impose too much on the thinking of their students. Children are capable of

FIGURE 3

Church history problem

Problem: If the present year is 2001, how long has the church been standing if it was founded in 1902?
Solution: 99 years

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FIGURE 4

Avenue of the Arts problem

Problem: The church is located on the Avenue of the Arts, which is 8 blocks long. There are 3 light poles on each side of the street on every block. How many light poles are on the Avenue of the Arts?
Solution: 48 light poles

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communicating their ideas to others. Constraining children's thinking to fit our own idea of problem solving, which is often closed and convergent, may stifle creativity and motivation.

Summary

Samples of other children's problems and solutions are shown in **figures 3** and **4.** These problems are also culturally relevant because they provide historical information about the church and its location along the Avenue of the Arts. For example, Reverend Charles A. Tindley, a prolific writer of gospel hymns, became the pastor of Calvary Methodist Church, which was later renamed Tindley Temple, in 1902. The church was founded as John Wesley Methodist Episcopal Church in 1837.

After the children finished their work, the problems were read aloud to the class. The children enjoyed reading their problems, and almost all of them wanted to go to the board to write their problems and share the answers. We allowed some of the children to go to the board to present their work and solutions. Because of time constraints, however, not all children were able to participate in this activity.

Teachers can help students improve their problem-solving skills by using culturally relevant teaching. We fell short of this goal in our lesson because we were too focused on creating the problems. We wanted "nice" problems that were somewhat convergent and had obvious solutions. Unfortunately, we stifled some of the thinking and creativity that could have come out of the task. Moreover, we neglected to discuss the problems and allow the students to offer multiple solution strategies for each one. Student inquiry is important in learning the problem-solving process (Campbell and Johnson 1995). These students could have benefited from seeing the strategies that others used. The students' work also could have become a springboard to reinforce the use of mathematical operations and the strategies needed to solve nonroutine mathematics problems (Malloy and Malloy 1998).

For some in the African American community, the church is the source of spiritual, social, intellectual, and political power. The activity presented in this article is culturally relevant because it increased the children's awareness of the power of the church to reach out to the community and the power of the community to provide learning opportunities outside the classroom. Children are more likely to see the importance of mathematics if their experience with the discipline affirms their cultural experiences and upholds their identities by examining real problems that affect issues in their lives (Wlodkowski and Ginsberg 1995). Although teaching in this context is no panacea, it increases the possibility that all students will be actively engaged in problem solving, which increases the potential for academic success. Because all students are capable of creating and solving problems, we can enhance their mathematical understanding by using examples found in their own communities, then facilitating classroom discourse around the problems themselves. Culturally relevant teaching opens the classroom discourse to different ways of knowing and talking about mathematics and helps all children learn to decipher its oral and written codes (Delpit 1998).

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