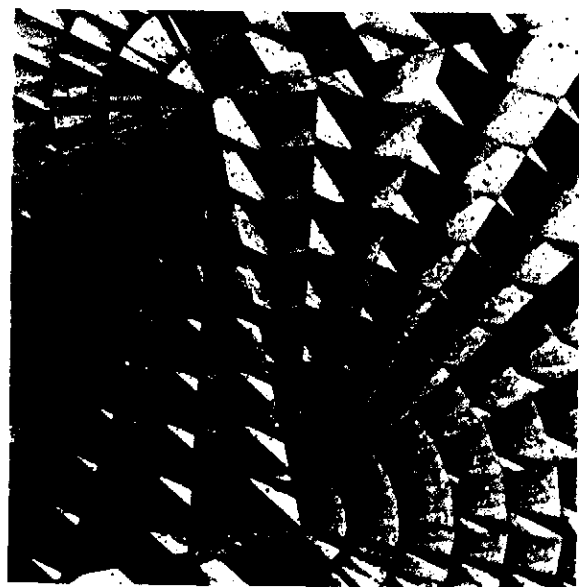


# Changing Faces of Mathematics

*Perspective*  
**African Americans**



National Council of Teachers of Mathematics

# The Use of "Call and Response" Pedagogy to Reinforce Mathematics Concepts and Skills Taught to African American Kindergartners **7**

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The purpose of this discussion is to present one form of African American culture used successfully in reinforcing basic skills in mathematics with African American kindergartners. Cultural experiences enhance learning, especially when these experiences are highly valued and frequently used by members of a group. One such experience among African Americans is the use of the *call-and-response* mode in sacred and pleasurable interactions. This paper will discuss a successful use of call-and-response pedagogy in teaching mathematics to African American prekindergartners (three- and four-year-olds) and kindergartners (five-year-olds). The pedagogy is grounded in aural and oral communication, cultural patterns of religious and secular social group behavior, the use of hands, fingers, and rhythmic "tapping" to reinforce previously learned number sequences and relationships.

Nearly all the African American children enrolled in the Martinez School entered at age three. They came from every socioeconomic background and from all parts of New Orleans, including surrounding suburbs and distant locations such as Kenner and Gretna. Children were provided with bus and van transportation to and from school. The school day lasted four hours, starting at nine in the morning and ending at one in the afternoon. Specific goals and objectives were formulated for each age group. By the end of the school year they were taught:

Three-year-olds	Four-year-olds	Five-year-olds
1. Number recognition	1. Number sequences	1. The concept of <i>one more</i>
2. To count up to 20	2. To count to 50	2. To count forward and backward up to 100
3. To write each number from 1 to 20	3. To write each number from 1 to 50	3. Double-digit addition (without carrying)
4. To write each letter of the alphabet, upper and lower case	4. Single-digit addition	4. Subtraction
5. Word recognition and decoding	5. Individualized reading	5. Reading and writing
6. To write their names	6. To write words and sentences	

PRE-KINDERGARTEN PREPARATION

## SMART HANDS

Mildred Bernard Martinez used an approach that empowered prekindergarten and kindergarten children to take control of their learning. The children gained—in Piaget's ([1932] 1965) terms—*autonomy* by viewing their hands as extensions of their thoughts and mental processes. In her approach, hands and fingers belonged to each person and could do things, could fulfill the wishes of each person on command. This sent a powerful message to the young children, transferring action and inaction from the person to the person's hands. Children were taught that they had *smart* hands that could do most anything. No longer could one place blame for failure on the inability of the mind to solve a problem. Perhaps, it was suggested, you were not using your hands in the best possible ways to help you solve the problem. In this approach, the blame now is transferred from the delicate and sensitive affective domain with accompanying feelings of incompetence and lack of self-confidence to an extension of one's *appendage outer self*—the hands and fingers. This notion seems to have something in common with Kamii's (1985) discussion of autonomy, that to the extent that the child becomes able to govern himself, he or she is less governed by other people. This allowed teachers to exercise high expectations, a correlate of an effective school (Edmonds 1979). It also placed the responsibility on each individual pupil to perform, with very little tolerance for excuses. In the course of the day, this was often challenged and tested by pupils.

One typical example of testing this approach was made by a four-year-old who refused to engage in the writing assignment during class time. The teacher walked over and quietly asked, "Why aren't you using your hands to write the number?" The boy replied, "Aww, my hands are lazy today and don't feel like writing. They're tired and need to take a rest." "OK," replied the teacher, "but when we go outside for recess, you will have to wake up your hands and stay with them in the room to exercise your hands and make them smart and strong." After a few minutes, the boy yelled out, "Look, look, my hands woke up. They're being smart hands now!" as he returned on task.

The use of hands and fingers in teaching mathematics to kindergartners has been well documented in studies by Ginsburg (1977), Jensen and Spector (1984), Baratta-Lorton (1976), and Ford (1987). The Martinez approach seems to have something in common with other techniques involving finger-counting systems from African and American Indian communities and the medieval system catalogued by the Venerable Bede. Zaslavsky (1979, 1994) presented a rationale for allowing—even encouraging—children to count on their fingers, citing number words from many languages that derive from names for gestures. Classrooms in the Martinez School were often filled with the voices of children engaged in the task, reinforcing one another in the search for solutions and sharing knowledge verbally.

In call-and-response teaching, nonverbal communication and other gestures were used to help clarify abstract forms of mathematical reasoning. This helped children to conceptualize, to form mental images in counting and addition. Mildred Martinez postulated that children between the ages of three and five years have a higher tolerance for the reteaching of concepts or the retelling of a story. She referred to this characteristic as *delight in repetition*. Studies have long shown that children when told a story—such as "Goldilocks and the Three Bears"—*remembered* every scene, situation, and character in the story. If the story was retold omitting any part of the original *first telling* of the story, the three-to-five-year-old was quick to respond to the storyteller by correcting the change from the original version. Kindergartners, she concluded, had more resilience for repetitive learning—condemned by many educators as *drill*. Beyond the age of six years, she found this criticism for the most part to be valid. As children grow older, there seems to be less tolerance for repetitive

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learning. The call for mathematical reasoning that is purely analytical by many educators often fails to account for age and developmental differences, especially the willingness of three-to-five-year-olds to accept repetition of tasks and to feel secure in the imprint of acquired knowledge and their unwillingness to deviate from that learned imprint.

What follows is a specific example of the procedure used in the Martinez School. The teacher (M) pointed out to the children that they were given a pair of *smart hands* that do many things. In an aural and oral approach, a typical dialogue with the entire class would be something like the following:

#### *Dialogue and Discussion*

*M:* Your hands are going to help you to learn. These hands will help you to understand, to do things in school. Did you know that your hands can talk?

*Class:* Nooooo! [*Nearly all respond in disbelief.*]

*M:* Yes! You have talking hands!

*Class:* Ohhh, noooo! [*Giggling to one another, while looking at their hands.*] My hands can't talk!

*M:* What does this mean?" [*Making a number of different gestures, e.g., waving a pointed index finger ... meaning no; waving hello and goodbye; "come here" gesture; palm out ... meaning "stop"; thumbs up gesture of approval; clapping hands to praise, etc....*]

*Class:* Ooooooh! Yes.

*M:* Your hands can do many things. Your hands can help you to dress. They can feed you when you are hungry. They help you to bathe. Your hands can make a person feel good when you give someone a great big hug. In school, your hands are going to help you to write.

#### *Call-and-Response Technique*

*M:* Open your hand. Look at it. Do you have anything in your hand?

*Class:* No!

*M:* Your hand is empty!

*Class:* Yes.

*M:* When your hand is empty, you have nothing in your hand! What do you have in your hand?

*Class:* Nothing!

*M:* What do you have in your hand?

*Class:* Nothing!

*M:* Another way of saying nothing is zero! What do you have in your hand?

*Class:* Zero!

(Repeat a few times until all children are responding verbally.)

*M:* Now, let's put one finger in your hand. What do you have in your hand?

*Class:* One!

The teacher explained that when we place one finger in the hand, we add one to zero. Children were able to build connections between the concrete use of one finger and the abstract symbol 1 or number one. They responded in a chorus: "One and zero are one." The concept was repeated in a call-and-response format several times until each child was responding. The teacher wrote the numeral 1 on the chalkboard, then zero under it with a plus sign, then an underline ("are"), followed by the sum, 1:

$$\begin{array}{r} 1 \quad \text{one} \\ + 0 \quad \text{and (+) zero} \\ \hline \quad \text{are} \\ 1 \quad \text{one} \end{array}$$

This exercise was repeated in call-and-response format several times until all had mastered the concept. The new lesson uses the same pattern above, but with two fingers. The class responds: "Two plus zero are two." The same pattern is used for the numbers 3, 4, 5, 6, 7, 8, 9, 10.

## THE TAPPING TECHNIQUE IN ADDITION

The *tapping* technique, used by four- and five-year-olds in the Martinez kindergarten, is a rhythmic approach in both problem solving and retention of skills needed to obtain the correct answer. The child is taught when working independently on an addition problem such as  $4 + 2$ , to say: "Four and two are ..." (then tap twice using the index finger or pencil [or pointer at the chalkboard] while counting "5, 6," the correct sum being 6). Another example is  $4 + 3$ , where the child would say, "Four and three are ..." (then tap three times while counting "5, 6, 7," the correct sum being 7). The tapping technique is also kinesthetic and produces a rhythmic sound that helps the child learn and retain the process of obtaining the correct answer. This is an interim technique that is used only until the child has memorized the addition facts and no longer needs to engage in tapping.

This Martinez School technique seems to be supported in the research of Groen and Resnick (1977), Ginsburg and Russell (1981), and in subsequent discussions on *counting all* and *counting on* strategies used by four-year-old children to combine and count separate sets in order to get a new set. Given, for example, the addition problem above,  $4 + 2$ , a counting-all strategy would involve the child's counting both sets from the beginning, "One, two, three, four—five, six," whereas counting on, as Ginsburg described, is a more advanced and easier approach in that the child counts as follows: "Four—five, six." Tapping reinforces a counting-on approach.

## WORD PROBLEMS

In a whole-class follow-up activity at their seats, pupils copy and solve on their tablets addition problems written on the chalkboard. They also learn to write the *word names* (one, two, three, ..., seven, eight, ..., etc.) of each number. While this is taking place, children are called in small groups to a table in the room. Additional reinforcement to ensure understanding is taught in small groups using manipulatives such as small cubes, wood blocks, and a large (two feet by three feet with two- and three-inch wooden beads in different colors) abacus. Each individual child in the group is required to solve an addition word problem as the other children in the group listen and observe. For example, the teacher takes six blocks and divides them into two sets of four and two, with a fun story: "I want to make a choo-choo train. If I take these four cars and add two more cars, how many cars will there be in the train?" The child is allowed to handle the blocks and to discover the answer. Different word problems are presented at the small-group table to each child. All the children gain a knowledge of formal addition by watching and participating. The abacus is used later in an entire class call-and-response review of the concepts *one more than* and *one less than* and in counting backward. Throughout the day, verbal interaction that focused on learning specific concepts was emphasized both in reading and in mathematics.

## SUBTRACTION

In regard to children's learning of the basic arithmetic facts, Cobb and Merkel (1989) emphasized that *thinking strategies*—the child's use of a known sum or difference to find an unknown sum or difference—are crucial in a problem-centered approach. Their experiments in the second-grade curriculum point to the conclusion that in the early grades thinking strategies are compatible with mental computation. Children use mental computation strategies in their thinking strategies and computational algorithms.

In the Martinez School, instructional activities applied the call-and-response method to connect kindergartners' informal thinking strategies with formal mathematics skills through the use of concrete examples that were both enjoyable and reinforcing. In teaching subtraction, Mildred Martinez (M) used the call-and-response method in the following way. She held up a marshmallow to the entire class:

M: Look what I have. What is this?

Class: A candy ... nooo ... a marshmallow!

M: [*Placing the marshmallow in her open left hand*] "What do I have in my hand?"

Class: A marshmallow.

M: How many marshmallows do I have in my hand?

Class: One!

M: How many?

Class: One!

M: Now, I'm going to take away this one marshmallow from my hand. [*She put the marshmallow in her mouth and ate it as the children watched in astonishment.*]

M: [*Opened her empty left hand*] "How many marshmallows do I have in my hand now?"

Class: None!

M: What's in my hand?

Class: Nothing!

M: And what is another way to say "nothing"?

Class: Zero.

M: [*Writing on the chalkboard*] One take away one is zero.

$$\begin{array}{r} 1 \quad \text{One} \\ - 1 \quad \text{take away one} \\ \hline 0 \quad \text{is zero} \end{array}$$

The teacher then produces a large bag of marshmallows and walks around the room placing one marshmallow on a napkin in front of each pupil, with instructions not to touch it until told to do so. When each pupil has one marshmallow, the teacher repeats the call-and-response lesson:

M: Everyone, put the marshmallow in your left hand. [*Each pupil does this.*] How many marshmallows do you have in your hand?

Class: One!

M: How many?

Class: One!

M: Now, take away the marshmallow and eat it. [*Smiles abound; pupils giggle in delight.*] Look at your left hand. What do you have in your left hand?

Class: Nothing.

M: And what is another way of saying "nothing"?

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**In the Martinez School, instructional activities applied the call-and-response method to connect kindergartners' informal thinking strategies with formal mathematics skills through the use of concrete examples that were both enjoyable and reinforcing.**

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*Class:* Zero!

*M:* OK. Let's all say ... [*everyone repeats in unison*]: One take away one is zero.

The math fact is written on the chalkboard, and all the pupils copy it onto their tablets.

The next lesson involves two marshmallows. Two marshmallows are placed in the hand. One is taken away and eaten. What is left is one marshmallow. Children respond in a call-and-response chorus: "Two take away one is one!" This math fact is written formally on the chalkboard. The remaining one marshmallow is used to repeat the first lesson: "One take away one is zero." Children were taught two very important concepts in a short time. (Note that this was the last "eating-a-marshmallow" lesson for the day.) Subsequent "take away one" concepts using numbers 3, 4, 5, 6, ..., 10 were taught using concrete objects and the abacus. Each time, the formal subtraction example was written on the chalkboard and pupils copied it on their tablets.

## CONCLUSION

The Martinez School approach seems to demonstrate that African American primary school students perform at higher levels when they are taught—

1. in a holistic social climate, that is, one that clarifies the meanings and connections between the following: informal and formal thinking, home language and school language, memory facts and standardized tests, relational learning styles and analytical learning styles, and verbal and nonverbal communication. This notion seems to share some of the findings in studies by Ginsburg and Baron (1993), Gay and Abrahams (1973), Good and Salvia (1988), Williams and Rivers (1972), Heath (1982), Hilliard (1976), Hale (1981), and Hall (1976).
2. in a school climate that is supportive and caring.
3. in a learning environment that provides opportunities for frequent and consistent monitoring of explicit curricula content to be learned with teachers or tutors present to help small study groups understand solutions to problems. In the Martinez School, small-group instruction follows each whole-class call-and-response lesson.

Small-group activity took place throughout the day. Individualized instruction and one-on-one review of new concepts were addressed in small groups in a nurturing climate of daily feedback and assessment. Students were made to feel comfortable in the group, to acknowledge that "I know this ... but I don't know that!" Peer support and reteaching, coupled with entire class call-and-response learning, provided each individual child with mastery levels of mathematics concepts. Such techniques worked successfully with African American children in New Orleans.

## SUMMARY

This case study highlights the need for mathematics educators to find alternative ways to transmit computational skills to African American children. The use of pedagogy and techniques that recognize cultural patterns embedded in the African American experience can go far in facilitating the teaching of mathematics skills.

It is emphasized here that children, aged three to five years, enjoy *repetition*. Mildred Martinez felt that age six was too late to implement the same intensity

of repetition exercises used with kindergartners. She believed that at age six and beyond students needed more developmentally appropriate strategies that move in the direction of current mathematics reforms. Her goals were to equip preschoolers with functional skills in basic math, and she did this quite well.

*Postscript:* The late Mildred Bernard Martinez was my mother.

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