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Source: *Journal for Research in Mathematics Education*, Vol. 28, No. 6, Equity, Mathematics Reform, and Research: Crossing Boundaries in Search of Understanding (Dec., 1997), pp. 697-708

Published by: National Council of Teachers of Mathematics

Stable URL: <http://www.jstor.org/stable/749638>

Accessed: 05/10/2009 03:15

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## It Doesn't Add Up: African American Students' Mathematics Achievement

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Mathematics education has been heralded for its leadership role in the U.S. school reform effort (Stein, Grover, & Henningsen, 1996; Grant, Peterson, & Shojgreen-Downer, 1996). Prominent in the reform of mathematics education is the call for students not merely to memorize formulas and rules and apply procedures but rather to engage in the *processes* of mathematical thinking, that is, to do what mathematicians and other professional users of mathematics do. The revamped mathematics education program is based on engaging students in problem posing and problem solving rather than on expecting rote memorization and convergent thinking. These changes in mathematics education suggest that mathematics teaching must build on students' learning and on their ability to pose and solve problems previously considered too difficult for their age-grade levels (Carpenter & Fennema, 1988; Fennema, Franke, Carpenter, & Carey, 1993).

Despite the much talked about changes in mathematics education, African American students continue to perform poorly in school mathematics (Secada, 1992). Some have argued that African American children's poor mathematics performance is the result of a discontinuity that exists between students' home language and the perceived "precision" of mathematics and mathematical language (Orr, 1987). Others have suggested that the content of school mathematics is so divorced from students' everyday experiences that it appears irrelevant (Tate, 1994). However, few have situated the mathematics performance of African American students into the larger context of mathematics teaching and learning in U.S. schools. This discussion attempts to do just that and suggests some direction for further research on the mathematics performance of African American students.

### *Why African Americans?*

Some may ask, why focus on African American students? The telling statistics on the life chances of African Americans suggest that whenever we can improve the schooling experiences for African American students, we have an opportunity to reverse their life chances. A disturbing percentage of African American males are involved with the criminal justice system (Miller, 1997). More African American males are in jail than in college,<sup>1</sup> and today, for the first time in our history, more African American males than Whites are in jail (*ibid.*). African American students are 2 to 5 times more likely to be suspended (and at a younger age) than

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<sup>1</sup>The total number of African American inmates (includes all ages) exceeds the total African American male college population, which is primarily between the ages 18 and 25.

White students (Carnegie Corporation of America, 1984/85). The dropout rate for urban, inner-city African American youth is 36% and rising (Whitaker, 1988). And although graduation from high school is no guarantee of success in life, a life without a high school diploma is almost certain to be unsuccessful—economically and socially.

In the 1950s and 1960s civil rights leaders declared literacy to be the key to full citizenship for African Americans (Morris, 1984). If African Americans could become literate they could not be denied the franchise in those southern states that had imposed literacy tests as a condition for voting. They could begin to read and discern for themselves the political practices that could lead to liberation. Much like the work of Paulo Freire (1970), these efforts toward increased literacy for African Americans were infused with notions of developing “critical consciousness”—an ability to read both the world and the word.

Today, in the 1990s, Bob Moses, one of the stalwarts of the civil rights movement, has argued that mathematical literacy represents the “new” civil rights battleground (Jetter, 1993). Moses asserts that because of the crucial role of algebra as a curricular gatekeeper, urban students cannot continue to be tracked out of it; in the current arrangement of the curriculum, access to higher level mathematics, beginning with algebra, can mean increased educational and economic opportunity for students.

### *The Culture of the U.S. and the Culture of Mathematics*

Although this discussion is focused on African American students' mathematics achievement, it is important to situate it in the larger context of mathematics teaching and learning in the U.S. The Third International Mathematics and Science Study (TIMSS) (U.S. Office of Education, 1996) revealed that U.S. school children continue to lag behind students in other highly technological nations in mathematics and science achievement. The reasons for these lags are multiple—teachers without adequate preparation in mathematics and science, unimaginative approaches to teaching, teacher misassignment, poorly constructed textbooks. But it is more than what happens in our classrooms that contributes to the creation of a mathematically illiterate culture. Mathematics functions as a feared and revered subject in our culture. We fear it because we believe that it is too hard, and we revere it because we believe that it signals advanced thinking reserved only for the intelligentsia.

Ours is a nation where no one would readily admit to being unable to read, but many proclaim with pride their inability to balance their checkbooks or compute the amount of interest on a loan. Not knowing how to read or write carries a stigma across race, class, and gender lines. People who cannot read and write attempt to mask that fact by using a variety of strategies. They pretend that they cannot see without their eyeglasses. They rely on their memories to pretend to read what they have heard many times before, or they grasp at context clues to make meaning from the meaningless squiggles on signs and paper.

Contrast this behavior with that of people in our society who struggle with mathematics. As Stevenson reported (1992), Asian parents attributed their students' mathematics failure to lack of effort, whereas U.S. parents were more likely to suggest that

their children's poor mathematics performance was attributable to a lack of innate ability. In the U.S. is found a cultural belief that either one "has it" or does not when it comes to mathematical ability, and the way to "get it" is through genetic inheritance.

As previously stated, it is acceptable in our society to be mathematically inept. Although hardly anyone will admit to being unable to read and write, Americans often matter of factly comment on their limited mathematics skills. Mathematical ability has come to be associated with "nerdiness" or "geekyness." Our cultural portrayals of the mathematically adept are White males with horn-rimmed glasses and plastic pocket protectors. These images do not prompt our children to embrace mathematics as a field of study or a necessary skill. This distortion and mystification of mathematics and its uses have contributed to our positioning it as unattainable (and undesirable).

We also have to understand that as our economy has changed, so has the role of mathematics (and science) teachers. Formerly, a high school education and a work ethic could allow one to find reasonable employment and provide for oneself and one's family. In today's more bifurcated economy, people are either highly educated (or skilled) or poorly educated (and unskilled). In the earlier era, mathematics teachers were charged with using their subject area as a curriculum sieve, sifting and winnowing to select the top students to go on to higher mathematics. In our current highly technological, global economy, few Americans can afford to be left out of high-level mathematics. Thus, today's mathematics teachers must conceive of their subject area not as a sieve but as a net that gathers in more and more students. This paradigmatic shift has been difficult for our students as a whole, but it has been particularly difficult for African American students.

But some people do well in mathematics in our society. Why? Certainly, individual differences exist that cannot be easily generalized to explain mathematical abilities. However, statistically we can see whole-group patterns that may suggest some tendencies. White middle-class male students typically do well in mathematics, as do some groups of students of Asian descent. Is there anything about the culture of mathematics that is compatible with White middle-class male students' culture and experiences? Is there anything about White middle-class male students' culture that makes it compatible with mathematics as it is taught in our schools?

Mathematics teaching in our schools emphasizes repetition; drill; convergent, right-answer thinking; and predictability.<sup>2</sup> Students are asked to perform similar tasks over and over. They are rarely asked to challenge the "rules" of mathematics. They are rarely asked how their prior knowledge and experience might support or conflict with school mathematics. Middle-class culture demands efficiency, consensus, abstraction, and rationality. These features of the culture are inherently neither good nor bad. However, they may reflect the experiences and understandings of one segment of our society. Boykin and Toms (1985) suggest that some

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<sup>2</sup>This description of current mathematics practice is not reflective of those school programs that have adopted the recommended NCTM curriculum Standards.

features of African American cultural expression<sup>3</sup> include rhythm, orality, communalism, spirituality, expressive individualism, social time perspective, verve, and movement. Once again, there is nothing inherently good or bad about these cultural features. However, these kinds of cultural expression are neither reinforced nor represented in school mathematics. Further, school mathematics curriculum, assessment, and pedagogy are often closely aligned with an idealized cultural experience of the White middle class (Cohen, 1982; Joseph, 1987; Romberg, 1992). Moreover, this problem is subtle and difficult to diagnose (see e.g., Silver, Smith, & Nelson, 1995; Tate, 1995).

### *Beyond Surface Differences*

But students' social context is not alone in having an impact on students' mathematics achievement. The relationship between mathematics and culture continues to be deciphered. There are those who suggest that mathematics is "culture free" and that it does not matter who is "doing" mathematics; the tasks remain the same. But these are people who do not understand the nature of culture and its profound impact on cognition (Cole, Gay, Glick, & Sharp, 1971).

Culture refers to the deep structures of knowing, understanding, acting, and being in the world. It informs all human thought and activity and cannot be suspended as human beings interact with particular subject matters or domains of learning. Its transmission is both explicit and implicit. Thus, even though African American students are a part of almost every social strata and their social context may affect what experiences they have and how they view the world, their cultural knowledge, expressions, and understandings, which may be transmitted over many generations, may share many features with African Americans across socioeconomic and geographical boundaries.

Part of the deep structure of African American culture is an affinity for rhythm and pattern.<sup>4</sup> African American artistic and physical expressions demonstrate these features in sophisticated ways. Jazz, gospel music, rap, poetry, basketball, sermonizing, dance, fashion—all reflect African American influences of rhythm and pattern. But these influences are rarely connected to any mathematical foundations. I am not suggesting that we should "mathematize"<sup>5</sup> all cultural expressions, such as art and music, but rather that it may be important to help students see the mathematical links that exist between what they know and appreciate.

School mathematics is presented in ways that are divorced from the everyday

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<sup>3</sup>I do not mean to imply that there is one monolithic African American culture. However, scholars such as Nobles (1986) and Boykin and Toms (1985) have identified features extant in African American cultural expression that appear with regularity throughout African American communities.

<sup>4</sup>It is important that this notion not be read as the stereotypical "all Black people got rhythm." Instead, what I am suggesting here is that rhythmic expressions in music, dance, art, and so on, are consistently valued and reinforced in African American cultural expression. Individuals within the culture may have no particularly rhythmic skills or interests.

<sup>5</sup>The term *mathematize* is used to explain the practice of quantifying nonmathematical phenomena. See Putnam, Lampert, and Peterson (1990).

experiences of most students, not just African American students. Thus, poor mathematics performance in the U.S. cuts across cultural groups. But some disturbing patterns about the performance of African American students need to be examined. Oakes et al. (1990) found that low-income African American students are more likely to be clustered in low-ability mathematics classes. As a school's African American enrollment increases, the proportion of classes identified as high ability diminishes. Schools where African American students constitute the majority have less extensive and less demanding mathematics programs and offer fewer opportunities for students to take such gatekeeper courses as algebra and calculus that lead to increased opportunities at the college level and beyond. Oakes and her colleagues also found that schools with high concentrations of African American students tend to have fewer teachers judged to be highly qualified in mathematics.

### *Teaching for High Performance in Mathematics*

Although much of this discussion has dealt with the way mathematics is constructed and regarded in the U.S., I would be remiss if I did not address the notion of pedagogy. It is with changed notions of pedagogy that I believe we have the best opportunity for changing the achievement levels of African American students. My work has focused on successful teachers of African American students (e.g., Ladson-Billings, 1994, 1995). The work of such teachers is in high relief from that of what Haberman (1991) calls "the pedagogy of poverty." This pedagogy of poverty includes such routine teaching acts as "giving information, asking questions, giving directions, making assignments, monitoring seatwork, reviewing assignments, giving tests, reviewing tests, assigning homework, reviewing homework, settling disputes, punishing noncompliance, marking papers, and giving grades" (p. 290). Haberman points out that taken separately these acts might seem "normal." However, "taken together and performed to the systematic exclusion of other acts, they have become the pedagogical coin of the realm in urban schools" (p. 291).

Further, Haberman suggests that the pedagogy of poverty appeals to several constituencies (p. 291). Below I elaborate on his list of to whom this pedagogy appeals and make some connections to mathematics teaching and learning:

*It appeals to those who themselves did not do well in school.* Too many of the teachers assigned to urban classrooms fail to enjoy intellectual pursuits. Their own work in school was mediocre, and teaching was a choice of convenience rather than one of informed and reflective decision making. These teachers typically were not good mathematics students, and their orientation to mathematics is as a rule-governed, right-answer, "hard" discipline.

*It appeals to those who rely on common sense rather than on thoughtful analysis.* Teachers who practice this kind of pedagogy are more likely to suggest that students need to learn or do something because that is the way they learned or did it. Rather than make curricular and instructional decisions on the basis of empirical research or a systematic study of students' classroom performances, they do what "feels" right. Thus, strictly following the mathematics textbook and completing problem sets become the rule.

*It appeals to those who fear people of color and the poor and who have a need for control.* It is interesting to walk into schools or classrooms thought to be “good” urban classrooms. Often, what makes them “good” is that they are unnaturally quiet. Teachers and administrators sometimes become so consumed with the notion that African American children must be managed that they forget that they need to be taught. Maintaining order and keeping children under control become the preoccupation of the teachers Haberman describes. That order may be best maintained by, in these teachers’ view, giving students mundane, routine mathematics tasks that do not invite much discussion and contestation.

*It appeals to those who have low expectations for children of color and the poor.* As was previously mentioned, a notion prevails in American culture that academic excellence is a result of genetic good fortune. This concept—that some students “have it” whereas others do not—is particularly pernicious when directed toward African American students. Teachers who presume that because students are of a particular race or ethnicity they cannot be expected to perform at high levels in mathematics fail to present those students with a challenging, intellectually rigorous mathematics curriculum. Instead, their mathematics curriculum is best described as overly directive and controlling.

*It appeals to those who do not know the full range of available pedagogical options available.* It stands to reason that if teachers have not performed well in school, approach teaching unsystematically, fear their students, and hold low expectations for them, they are likely also to possess a limited teaching repertoire. Calling on past (bad) practices, these teachers tend to reproduce the kind of unimaginative, stifling pedagogy that has failed to serve students of color for many years. Their classrooms are not unlike that described by Ayers (1992, p. 259):

Visiting a fourth-grade class, I was greeted by the teacher. “Welcome to our class,” she said. “I’m on page 307 of the math text, exactly where I’m supposed to be according to board guidelines.”

There was not much going on—two students were asleep, several were looking out the window, a few were reading their math books. I discovered later that virtually every student in the class was failing math. But this teacher was doing her job, moving through the set curriculum, dutifully delivering the material, passing out the grades. If the students did not learn math, that was not her responsibility.

In contrast to this pedagogy of poverty, I have had the pleasure of working with teachers who enacted a culturally relevant pedagogy. I have documented their work in a number of places (Ladson-Billings, 1994, 1995). However, in keeping with an emphasis on mathematics, I want to talk about how one teacher, whom I call Margaret Rossi, developed a pedagogy designed to ensure high mathematical achievement among African American students.

Margaret Rossi is an Italian American woman in her mid-40s. She began her teaching career in the late 1960s as a Dominican nun. She has taught students in both private and public schools, from White wealthy communities to low-income communities of color. During the study, she was teaching sixth grade in a working-class, low-income, predominantly African American school district. Although regarded as a strict

teacher, she knew that students respected her for being demanding yet caring.

Mathematics in Margaret's class was a nonstop affair. She spent little or no time on classroom routines like taking roll, collecting lunch money, or dealing with classroom management. Margaret's classroom was always busy. Although her students were engaged in problem solving using algebraic functions, no worksheets were handed out, no problem sets were assigned. The students, as well as Margaret, posed problems.

From a pedagogical standpoint, I saw Margaret make a point of getting every student involved in the mathematics lesson. She continually assured students that they were capable of mastering the problems. They cheered each other on and celebrated when they were able to explain how they arrived at their solutions. Margaret's time and energy were devoted to mathematics.

Margaret moved around the classroom as students posed questions and suggested solutions. She often asked, "How do you know?" to push students' thinking. When students asked questions, Margaret was quick to say, "Who knows? Who can help him out here?" Margaret helped her students understand that they were knowledgeable and capable of answering questions posed by themselves and others. However, Margaret did not shrink from her own responsibility as teacher. From time to time she worked individually with students who seemed puzzled or confused about the discussion. By asking a series of probing questions, Margaret was able to help students organize their thinking about a problem and develop their own problem-solving strategies. The busy hum of activity in Margaret's classroom was directed toward mathematics.

All of Margaret's students participated in algebra, even though it was beyond what the district's curriculum required for sixth grade. Margaret scrounged an old set of algebra books from the district's book closet and exempted no one from the rigors of the class. One of Margaret's students was designated a special needs student. However, Margaret determined that with a few accommodations the student could remain in the classroom and benefit from her instruction. James performed well in the classroom. He participated in class discussions, posed problems as well as solved them, and accepted help from classmates when he struggled. By the end of the year, Margaret had convinced the principal that James had no need for services outside the classroom.

Although it is interesting to hear Margaret's story, it is more meaningful to understand her practice as a heuristic for solving the problem of poor mathematics achievement among African American students. Some of the tentative principles we can extrapolate from her teaching follow.

*Students treated as competent are likely to demonstrate competence.* Much of the literature on teacher expectations of student achievement helps us understand that when teachers believe in students' abilities, the students are likely to be successful. Conversely, when teachers believe that because of their race, social class, or personal economic situations students may not be intellectually able, student performance (and how it is assessed) confirms those beliefs. Margaret treated all students as if they were intellectually exceptional. She expected all of the students to perform at high levels of competence—and they did.



*Providing instructional scaffolding for students allows students to move from what they know to what they do not know.* Rather than worry over what students did not know, Margaret demonstrated the possibility of using the students' prior knowledge as a bridge to new learning. She instructed her students not to allow organization of tests or texts to distract or confuse them. She reassured them that they possessed key strategies for solving a variety of problems.

*The major focus of the classroom must be instructional.* Margaret made efficient use of her class time. From the moment the students entered the classroom until the time they were dismissed for recess, they were engaged in mathematics. Additionally, Margaret was engaged in mathematics instruction the entire time. She did not attempt to occupy the students with busy work. Instead, she was committed to the academic success of each student and accompanied each one on the instructional journey. Knowing that she was right there with them gave the students the assurance that their progress would be monitored and that they would never be allowed to stray too far off the instructional path.

*Real education is about extending students' thinking and abilities beyond what they already know.* Margaret Rossi's decision to teach her sixth graders algebra even when it was not mandated by her district's curriculum was a conscious effort to demonstrate to the students that they had the capacity to learn and perform at higher and more sophisticated levels than had been demanded of them previously. Instead of attempting to maintain the students at low levels of academic performance, Margaret provided challenging content for *all* the students.

*Effective pedagogical practice involves in-depth knowledge of students as well as of subject matter.* There is no disputing that effective teachers must be knowledgeable about content. Additionally, Shulman (1987) suggests that beyond a knowledge of their various content areas, teachers must know how that knowledge is best taught. Other researchers argue that teachers who are successful with diverse learners also are able to cultivate and maintain strong interpersonal relationships with their students (Foster, 1992).

Spindler and Spindler (1982) reported that teachers, perhaps unconsciously, favor those students whom they perceive to be most like them. This partiality takes the form of attending more to these students, valuing their responses more, and evaluating their performances more favorably. If teachers are to be more effective with African American students, they must develop a positive identification with them—to perceive them to be like them, that is, fully human and possessing enormous intellectual capacity.

#### *Filling the Research Void—"Complex Situations"*

One of the ways researchers might develop research agendas that respond to the need of classroom teachers and their students to improve mathematics performance is to understand the theoretical challenge of this work. A typical response to these issues is to function in a crisis-management mode—looking for ways to repair seemingly

irreparable classroom situations. I suggest here that a better way to address these problems is to develop more powerful theoretical rubrics for making sense of classroom practices and student performances. Two important heuristics for creating a “way of seeing” what is happening in mathematics classrooms are found in the work of Lave and Wenger (1991) and Waldrop (1992). The former gives us an understanding of the situated nature of learning, or situated cognition. The latter helps us develop notions of complexity. Together, they might be thought of as a theory of “complex situations.”

Situated cognition suggests that individuals do not learn things in a vacuum. Rather, learning occurs in social contexts. The kinds of mathematics learning that individuals do can be highly specific. Fasheh (1990) speaks of his mother’s understanding of pattern because of her work as a quilter. Similarly, when teaching adults to read in the south during the 1950s and 1960s, Clark (Clark, 1990) relied primarily on her students’ desires to gain employment, read and study the Bible, and participate in the political process as sources of reading motivation instead of trying to teach rudiments of sound-symbol relationships. Thus, success in mathematics for African American students may need to be deeply embedded in their everyday contexts. Instead of surface connections, such as changing the names of story problem characters, teachers will need to understand the deep structures of students’ experiences.<sup>6</sup> This may mean doing some things with students that look very “unmathlike”—interviewing them, having them write autobiographies, discussing their interests. To be successful at moving from students’ lives and interests to meaningful mathematics, teachers themselves will have to be very knowledgeable in mathematics. The work of Smith and Stiff (1993) illustrates this technique. Under the press of a state mandate for algebra for all students, they created a series of vignettes connected to students’ interests in which they embedded the basics of algebra. Their technique called for involving students in these high-interest stories until students’ interest waned. When the interest dissipated, a new story was begun. Their ability to move from story to story was linked to their knowledge of mathematics. They could (and did) embed the algebraic concepts and problems in any story. However, it was the interest in the story that kept the students engaged. This technique is important in light of the push to create high-technology programs for mathematics learning. These programs necessarily must choose some context, but they may not choose the “right” contexts.<sup>7</sup>

In addition to situating the teaching of mathematics in relevant student contexts, we need to recognize that human contexts or systems are necessarily complex. Casti (1994) and Waldrop (1992), constructors of “complexity theory,” suggest that phenomena (or tasks) are not just “complicated,” they are “complex.” The classroom

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<sup>6</sup>Knowing these deep structures goes beyond reading general descriptions of a culture to becoming a “student” of the specific individuals we teach.

<sup>7</sup>For example, my daughter’s middle school mathematics class participated in the highly acclaimed “Jasper Woodbury Series” created as a part of Vanderbilt University’s School for Thought program. Although she completed the assignments, throughout the study she complained that she was not particularly interested in Jasper and *his* problems. The Smith and Stiff (1993) project requires that the problems emanate from students in the classroom.

is a complicated place. But complicated phenomena and tasks typically can be reduced to the sum of their parts, whereas complex systems (e.g., human beings, communities, schools, and classrooms) are "more dynamic, more unpredictable, more alive" (Davis & Sumara, 1997, p. 117). Thus, classrooms are *both* complicated and complex.

Waldrop (1992) asserts that complex systems have three distinguishing characteristics. First they have the capacity to undergo spontaneous self-organization, in the process of somehow managing to transcend themselves. For example, in the process of solving a mathematics problem, individual students might contribute different ideas that help create a rubric or strategy for solving the problem that no one student would have developed independently. Second, complex systems are adaptive. Whether they be species, marketplaces, or individual organisms (or classrooms), they all change within changing environments (Davis & Sumara, 1997). Thus, a classroom within a dysfunctional school can be highly effective, as was true in the classrooms of the teachers I studied (Ladson-Billings, 1994). This is not to suggest that we should discourage systemic change; rather, the lack of schoolwide reform should not preclude individual teachers from developing effective practice within the system. Third, complex systems are qualitatively different from mechanical systems (e.g., cars, computers), which are "merely complicated" (Davis & Sumara, p. 118). One can understand complicated systems by analyzing each of its component parts. This analysis can make the system predictable and rule governed. Contrast that with the classroom. Merely examining each individual student (component) within the classroom tells the teacher little about the dynamic of the classroom (system). Yet, that is often precisely the approach we take. It is important to know and understand the individuals in the classroom, but it is equally important to understand how the group functions and how individuals relate to, and function with, the group.

Perhaps by melding notions of situated cognition with complexity theory we can provide teachers and researchers with a different type of lens through which to understand the classroom and a different type of tool to improve it. If we understand that the multiple contexts in which students live their lives have a variety of effects on the class system, we might begin to create the kinds of mathematics curricula and pedagogy that take full advantage of the adaptive, resilient, complex nature of learners in a classroom. Rather than presume that because of their race, culture, ethnicity, language, or other form of difference students are unable to succeed in mathematics, this lens might force us to ask how the mathematics we are teaching (and how we teach it) is changing the system. How might we construct mathematics learning situations that improve the system? When we look at other aspects of the curricula where students may be experiencing success, what can we discover about certain aspects of learning that work well in a classroom system?

Certainly enough literature documents the mathematics failure of African American students. What is lacking is the documentation of successful practice of mathematics for African American students. The challenge of improving the mathematical performance of African American students must be fought on three fronts: programmatic, personal, and political. Programmatically, we must participate in the development of meaningful and challenging curricula. Personally, we

must come to develop caring and compassionate relationships with students—relationships born of informed empathy, not sympathy. Politically, we must understand that our future as a people is directly tied to our children's ability to make the most of their education—to use it not merely for their own economic gain and personal aggrandizement, but rather for a restructuring of an inequitable, unjust society. Our students have immeasurable talents and innumerable strengths. That they do not do well in school in general and in mathematics in particular just does not add up.

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