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Source: *Theory Into Practice*, Vol. 34, No. 3, Culturally Relevant Teaching (Summer, 1995), pp. 166-173

Published by: [Taylor & Francis, Ltd.](#)

Stable URL: <http://www.jstor.org/stable/1476636>

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William F. Tate

Returning to the Root: A Culturally Relevant Approach to Mathematics Pedagogy

TREE AT THE OUTSKIRTS
Away, and alone;
Your roots, returning,
Spread under homes
At the village center.
(Kayper-Mensah, 1978, p. 12)

Over 60 years ago, Carter G. Woodson called for an approach to equity in mathematics education that built on African American tradition and experience. Woodson (1933/1990) argued, "And even in the certitude of science or mathematics it has been unfortunate that the approach to the Negro has been borrowed from a 'foreign' method" (p. 4). Woodson posited that education built strictly on the thinking, experiences, and desires of Whites was inappropriate for African Americans. What is the effect of this "foreign pedagogy" on African American student achievement in mathematics?

Although mathematics scores of African American students have improved in recent tests related to factual knowledge and basic skills, no growth was found on tests that measured more advanced levels of mathematical reasoning (Mullis, Lindquist, & Chambers, 1988). Secada (1992) suggests that these findings are consistent with the pedagogical focus of the previous decade: mastery of low-level, basic computational skills. Moreover, he argues that this represents a story of incomplete success, insofar as low-level compu-

tational skills are not deemed sufficient for true knowledge of mathematics. The findings also suggest that in our highly technological society, African American students are not prepared to use mathematics as a tool to negotiate the complex democratic processes of the United States (Tate, 1994c). How can educators address this problem?

In earlier discussions, I argued that Woodson provided an important framework to begin the rethinking and reconstruction of mathematics education for African American students (Tate, 1994b, 1994c). My intention here is to continue this line of inquiry with a discussion of an Africentric approach to mathematics education.¹ This analysis rests on the assumption that Africentricity is not a static ideology but rather a dynamic strategy for understanding the thinking and experiences of African American students in school mathematics. Moreover, my analysis is intended to contribute to the emerging literature on culturally relevant pedagogy (see, for example, Irvine, 1990; King, in press; Ladson-Billings, 1990, 1992, in press-a, in press-b), a literature that examines pedagogical efforts to move the African American child to "the village center."

A "Foreign" Pedagogy

What type of mathematics pedagogy must African American students negotiate to be successful in school? Typical mathematics pedagogy emphasizes whole-class instruction, with teachers describing a technique to solve a problem and students listening

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*THEORY INTO PRACTICE, Volume 34, Number 3, Summer 1995
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0040-5841/95\$1.25*

to the lecture. Students are then instructed to work alone on a set of textbook problems. In general, the textbook problems are similar to the problems from the lecture. This pattern is repeated daily. The purpose of this teacher-directed model of instruction is for students to produce correct answers to a narrowly defined problem. This pedagogical approach is consistent with findings of several studies of mathematics instruction (Fey, 1981; Porter, 1989; Stodolsky, 1988).

Unfortunately, the traditional approach to mathematics instruction is exactly the kind of “foreign method” of teaching described by Woodson. Today, the effect of this “foreign” pedagogy appears in different forms. For example, it is well documented that African American students are more likely to be tracked into remedial mathematics than White students (Oakes, 1990b). As the proportion of African American students in a school increases, the relative proportion of college preparatory or advanced sections of mathematics decreases (Oakes, 1990a). In comparison to White students, African American students have fewer opportunities to use technology in school mathematics (NSB, 1991). Moreover, African American students are provided less access to the best prepared mathematics teachers than White students (NSB, 1991).

Comparative statistics between African American and White students in school mathematics abound (see, for example, Secada, 1992). However, I do not think these types of comparative analyses always best describe the problems confronting the African American child in school mathematics. These research methods and findings suggest the “African American problem” in mathematics is one of space and location, implying that the African American student needs to experience what White students experience to be successful in school mathematics. Unfortunately, the paradigmatic boundaries of mathematics education, psychology, and mathematics (Kilpatrick, 1992) have often limited the “accepted” equity arguments for African American students to discussions of barriers that are quantifiable—e.g., the number of college prep courses taken, teacher qualifications, and computers and calculators in the school (Murnane & Raizen, 1988; Oakes, 1990a). All of these variables can be counted and analyzed. However, other African American student experiences in mathematics are more subtle and cannot be objectified with numbers.

Treisman (1985) conducted an ethnographic study of African American students who did not perform well in calculus (see also Fullilove & Treisman, 1990; Garland, 1993). Part of his study included interviewing the students’ calculus professors. He asked them to explain the African American students’ poor performance. In general, the professors attributed the poor performance of African American students to one of the following: (a) lack of motivation to succeed, (b) little family support, (c) poor academic preparation, and (d) economic deprivation.

Treisman was able to dispel each of these reasons in his study. He found that the students had outstanding high school academic records and excellent standardized test scores. Most of the students had regular study habits and were highly motivated. A large percentage of the students were from middle- to upper-class families that provided both financial and moral support.

More importantly, Treisman found that the African American first-year college students studied mathematics in isolation, and their school and personal lives were quite separate. The students’ tendency toward isolationism was not a student characteristic; it was their reaction to a hostile school climate. There was a lack of congruence between the African American students’ lives and the school environment. In response to these findings, Treisman and his colleagues developed a “talented and gifted” program that integrated high-level mathematics content and cooperative groups into the lives of the African American students. The mathematics achievement for participants improved dramatically.

Other scholars have explored the relationship between African American students’ experiences and traditions, and school mathematics. Stiff and Harvey (1988) found that African American students who attempted to center their lives and experiences within the process of acquiring knowledge about mathematics risked being put down by teachers for focusing on “extraneous matters.” Similarly, Silver and Nelson (in press), Tate (1994c), and Glaser and Silver (1994) describe how a group of African American middle school students were penalized for integrating their home experiences with the mathematics problem-solving process and not solving the problem using a White middle-class frame of reference. I have concluded that failing to provide African American students with mathematics curriculum, instruction, and

assessment centered on their experiences, culture, and traditions is a major obstacle to achieving equity in mathematics education (Tate, 1994c).

Linguistic research also has contributed to the understanding of the African American experience in mathematics. For example, Orr (1987) collected the daily work of her students over a 9-year period. She found that Black English vernacular (BEV) can affect a BEV speaker's concept of certain quantitative relationships. Orr (1987) concluded that if African American students were to be successful in school mathematics, they must be able to translate between standard English and mathematical ideas.

Orr (1987) argues, "If we teachers know where the difficulties can arise—which concepts can be misunderstood and in what ways—and if we know what features of BEV can play a part in these misunderstandings, the potential problems can be averted" (p. 9). Orr's remark suggests that mathematics teachers must invest time understanding the African American experience and be willing to incorporate this knowledge into their pedagogy.

Orr's research has been subject to criticism. Baugh (1994) argues that Orr's study revived the deficient hypothesis, a negative characterization of nonstandard English that assumes BEV lacks some vital linguistic content that is essential to success in mathematics. Baugh (1994) remarks that standard English as a dialect is more archaic than nonstandard English, but it is not more logical, and the history of English has not been developed by precepts of mathematics. Yet it is on this hypothesis that Orr built her arguments regarding African American language. Baugh (1994) calls for culturally-relevant educational procedures that build on the language and culture of the student. He suggests that mathematics programs should select problem-solving topics that interest the student and develop team projects to solve these problems.

Recommendations that suggest mathematics pedagogy should build on the thinking, interests, and experiences of African American students face a major philosophical barrier. Many scholars contend that the curriculum and pedagogy of mathematics have been and continue to be linked to Eurocentric precepts that exclude the African American experience (Anderson, 1990; Apple, 1992; Joseph, 1987). The Eurocentric philosophy of rational thought is closely associated with a form of elitism and social

stratification that looks to build the economic power of corporate entities and its White male leadership (Cohen, 1982; Ernest, 1991; Jefferson, 1784/1954; Smith, 1937).

Is it possible to develop high-level mathematical competence for African American students within a Eurocentric paradigm? Many scholars argue that African American students require pedagogy built on their thinking and experiences (Baugh, 1994; King, in press; Ladson-Billings, in press-b; Stanic, 1991; Tate, 1994b). However, this argument is not acceptable within the parameters of the Eurocentric approach to mathematics education (Ernest, 1991). My response is to explore the mathematical possibilities within the Africentric paradigm and practices of culturally relevant pedagogy.

Africentricity and Mathematics Pedagogy

The principles that undergird the Africentric philosophy of education were articulated by Woodson in *The Mis-Education of the Negro* (1933/1990). Woodson's major thesis is that African Americans have been educated away from their culture and traditions and have associated more with European values and traditions. Woodson (1933/1990) stated:

When a Negro has finished his [sic] education in our schools, then, he has been equipped to begin the life of an Americanized or Europeanized white man, but before he steps from the threshold of his alma mater he is told by his teachers that he must go back to his own people from whom he has been estranged by a vision of ideals which in his disillusionment he will realize that he cannot attain. (pp. 5-6)

In response to Woodson's thesis, Asante (1991) and others (Karenga, 1988; Keto, 1991; Stewart, 1992) have called for an alternative philosophy of education—Africentricity—that looks to center African American students within the context of their traditions and experiences so that they are better able to relate to other cultural perspectives. Asante (1987) argues that all analysis is culturally centered and develops from ideological assumptions; this is the most important lesson from modern intellectual history. The Africentric method looks to construct a world-view of communication—written and oral—of oppressed people (Asante, 1987). Specifically, this critical perspective places African ideals at the center of any analysis that involves African culture and behavior.

One feature of the Africentric movement has been the call for and analysis of culturally relevant pedagogy. Culturally relevant pedagogy is a pedagogy of opposition that builds on the thinking, experiences, and traditions of African American students (King, 1991; Ladson-Billings, 1990, 1992; Tate, 1994b). This is in stark contrast to traditional instruction that seeks to assimilate students into the existing social and economic arrangements. The primary purpose of culturally relevant pedagogy is to empower students to critique society and seek changes based on their reflective analysis (Ladson-Billings, 1992).

In the field of mathematics education, some scholars have theorized about culturally relevant approaches to mathematics education. For example, Stanic (1991) contends an important step toward equity in mathematics education is to question the epistemological foundation of the field. He argues that, taken together, culture practice theory and critical theory provide the foundation for a reform and research agenda in mathematics education.

Culture practice theory is based on the idea that knowledge is situated within particular contexts (Brown, Collins, & Duguid, 1989). In-school knowledge, according to this theory, is acquired by working alone to memorize rules and solving well-defined problem types. It is often narrow and difficult to transfer. In contrast, out-of-school knowledge is acquired by working in an environment to understand the causes of problems, solve ill-defined problems, and construct personal meaning (Lave, 1988; Lave, Smith, & Butler, 1988; Schoenfeld, 1988).

Stanic (1991) asserts that culture practice theory begins to address the discontinuity that exists between schooling and the other contexts of our lives. However, missing from cultural practice theory is any analysis of the relationship between cultural discontinuity and social inequality. Stanic contends that critical theory fills this void by providing a framework to explore the relationship between political and economic inequality and the school mathematics curriculum. Stanic's framework implies that one important purpose of mathematics education is to prepare citizens to engage in individual and collective social action. Thus African American students should be encouraged to use mathematics as an agent to change their out-of-school realities.

Africentric Mathematics Pedagogy in Action

For the past year I have been collaborating with Sandra Mason,² a teacher in a predominantly African American middle school located in an urban district in the southwest. I learned about Mason through a conversation with a city council representative, who described her as a public servant who went beyond the call of duty. He said her students were prepared to engage in economic and social debates on issues relevant to African Americans.

The data reported in this article were gathered in the first two phases of a multi-phase study of the teacher and her students. During the first phase, documents related to Mason's pedagogy (newspaper articles, legislative resolutions, videotapes) were collected and analyzed. During the second phase, Mason participated in an ethnographic interview (Goetz & LeCompte, 1984; Spradley, 1979) to discuss her background, pedagogical philosophy, and perspectives on curriculum, administrative support, and parent and community involvement.

Sandra Mason began teaching after raising her children. She has been teaching for 5 years, all in the same school district. Prior to receiving her teaching certificate, she was an entrepreneur, and worked in research and development. Mason spent most of her life in a small German farm town in Michigan. She was politically active in that community, working on such issues as education, crime, and taxes.

Mason's 5 years of teaching have all been spent in predominantly African American schools, and she has taught science for three of these years. Currently, she teaches in the laureate program of a middle school, a program designed to meet the needs of children identified as gifted in some area of schooling.³ The notion of "gifted" extends beyond traditional academic boundaries to include sports, art, drama, and music, which means that some of the students may be gifted in one area and yet unable to read. The students can be nominated for the program by parents, teachers, other members of the school community, or themselves.

Mason's classes are not regulated by mandated state and district curriculum guidelines. Thus she is free to develop the laureate program on the basis of her philosophical beliefs about the purpose of teaching. She contends that education should prepare students to solve real problems in their lives (Tate, 1994a). Building on students' experiences and realities

is important in her pedagogical decision making. She has constructed the program to be an interdisciplinary approach to community problem solving. Her overarching program goal is to develop students into active participants in the democracy (Tate, 1994a). Thus her classes are issue driven rather than content (e.g., mathematics) driven.

Mason has implemented a three-step approach to accomplish the aforementioned program goal. First, students are asked to pose problems they feel are negatively impacting their community. The intent of this task is to begin communication within a context that is familiar to the student and build on the student's thinking. Further, this process allows the students to see the world from the perspective of others. Next, the students are required to research the posed problem and develop strategies to resolve the problem. Finally, the students are encouraged to help resolve the community problem using the strategies they have developed.

The student problem-posing task has produced such topics as the AIDS epidemic, drugs, ethics in medicine, sickle cell anemia, and cities of the future (Tate, 1994a). Over the past 2 years, one of her classes has embarked on an effort to close and/or relocate 13 liquor stores within 1000 feet of their school. Two of Mason's students remarked:

James: Around the liquor stores there's people that hang out like prostitutes and drunks that mess with people. One time I was coming home and a drunk chased me home.

Terri: It's not the liquor stores that cause problems. It's just the commotion around them, like drugs, or drunks doing obscene things, you know, talking to young kids, trying to get them to give money and all that. (S. Mason, personal communication, July 1994)

Another student in the class, Mike, has experienced a more severe personal trauma related to the liquor stores. His mother is an alcoholic. Mason believes this fact has provided particular motivation for Mike in the effort to close the liquor stores. Mike and his classmates have developed a multi-step plan to move the liquor stores away from their school (Tate, 1994a).

First, they studied the local laws, codes, and regulations that applied to the situation, and found that the local laws were devised around an economic incentive system. The system created tax advantages and other fiscal incentives for liquor stores that lo-

cated in their school vicinity. In response to this discovery, the students reconstructed the incentive system to protect their school community from the liquor stores. This required the students to think about mathematics as a way to model their reality. Real situations in the students' lives were transformed into mathematical representations. Percentages, decimals, and fractions became more than isolated numbers as the students tried to mathematically manipulate these different, yet related, symbol systems and to link them to real problem solving and decision making.

The students then obtained a copy of the state beverage code from the state alcoholic beverage commission. This document lists all regulatory provisions for license holders. They analyzed this document to find infractions that could be applied to the liquor stores near their school.

The students also visited the city planning commission to obtain information on local zoning regulations. They were provided maps and information on permits and codes relevant to the problem. Using the maps, they determined the distances of the various liquor stores from their school. They then attempted to actually measure the distances using yardsticks. The students were amazed to find differences between the map estimates and their measurements. They learned that the city planners used more sophisticated equipment and techniques to measure the distance between buildings.

After this visit, the students planned a way to communicate their findings to the city council and other relevant government agencies. To assist with communication, the group contacted a local newspaper editor, who helped provide insight on how to organize mathematically-based arguments. Each student in the class was required to prepare a 3-minute sound-bite to represent the group's perspective. This activity resulted in many student questions about communicating with mathematics: Will percentages, decimals, fractions, or whole numbers make a more striking impression? How can we minimize the appearance of data or variables that may weaken the public's perception of our position?

Subsequently, the newspaper editor published an editorial describing the conditions surrounding the school. The students and Mason drove to the state capital and lobbied the state senate. The Associated Press reported the story, drawing national attention, which helped to open communication channels

with local agencies. The students presented a plan to the city council calling for the relocation of the liquor stores. The plan called for the council to offer land and economic incentives, such as tax abatements, to stores near the school willing to relocate. Also, stricter alcohol consumption regulations were proposed, with the hope that this would create an economic incentive for the liquor stores to move.

The actions of the students have resulted in some change. The police have issued over 200 citations to liquor store owners, and two of the 13 liquor stores were closed down for major violations. The city council adopted a resolution that liquor not be consumed within 600 feet of the school, and police are actively enforcing that resolution. Finally, the students have reconceptualized the role of education. School is not just a place to learn academic subjects. As one mem-

ber of Mason's class stated: "We stood up for what was right, we accomplished bravery" (Tate, 1994a).

Culturally Relevant Mathematics Pedagogy

Mason's pedagogy incorporates an awareness of the problems African American children face in education and society. She is different in that she has chosen to implement a pedagogy of social change. It is within the context of social change and community problem solving that "traditional" academic subjects emerge. The intent of Mason's pedagogy is the development of democratic citizenship through the strategic use of mathematics, science, or any other discipline. This requires preparing her students to be confident problem posers, problem solvers, and communicators. As Figure 1 illustrates, this process is radically different from more traditional approaches to mathematics pedagogy.

| Sandra Mason's Pedagogy | More Traditional Mathematics Instruction |
|--|--|
| <p>Problem Solving</p> <ul style="list-style-type: none"> • Investigating open-ended problems • Formulating questions from problem situations • Representing real situations verbally, numerically, or graphically | <p>Problem Solving</p> <ul style="list-style-type: none"> • Solving routine, well-defined problems |
| <p>Communication</p> <ul style="list-style-type: none"> • Persuading others with mathematics • Providing multiple responses to a problem situation | <p>Communication</p> <ul style="list-style-type: none"> • Answering questions that require only yes, no, or one answer |
| <p>Reasoning</p> <ul style="list-style-type: none"> • Reasoning with ratios and proportions • Reasoning with graphs, charts, and tables | <p>Reasoning</p> <ul style="list-style-type: none"> • Relying on teacher or book |
| <p>Connecting</p> <ul style="list-style-type: none"> • Connecting mathematics to other disciplines and to the world outside of school | <p>Connecting</p> <ul style="list-style-type: none"> • Learning skills out of context |
| <p>Number/Operations/Computation</p> <ul style="list-style-type: none"> • Developing numerical literacy • Creating mathematical algorithms | <p>Number/Operations/Computation</p> <ul style="list-style-type: none"> • Memorizing rules and algorithms • Rounding numbers out of context |
| <p>Statistics</p> <ul style="list-style-type: none"> • Using statistical methods to make decisions | <p>Statistics</p> <ul style="list-style-type: none"> • Memorizing rules |
| <p>Social Action</p> <ul style="list-style-type: none"> • Attempting to implement problem-solving strategies | <p>Social Action</p> <ul style="list-style-type: none"> • No political action |

Figure 1. A comparison of Sandra Mason's pedagogy and more traditional instruction.

Traditional instruction is dependent on mathematics topics that are provided in books. Mason's pedagogical approach is more closely associated with her students' needs and experiences. She compares herself to a "school bus driver," picking up students where they live and following their directions to a destination of their "choice" (Tate, 1994a). Central to her approach to teaching are the following: (a) communication between students, teacher, and outside entities; (b) cooperative groupwork; (c) investigative research throughout the learning process; (d) questioning content, people, and institutions; (e) open-end problem solving connected to student realities; and (f) social action.

Conclusion

Efforts to reform mathematics education continue at a rapid pace (NCTM, 1989, 1991). New instructional methods and curriculum recommendations replace older strategies for change. However, lost in this process are the realities of African American students. Sandra Mason's culturally relevant pedagogy serves as a reminder of Woodson's call for mathematics pedagogy built on the thinking and realities of the African American children. Mason's pedagogical strategies represent efforts to "center" her students in the process of acquiring knowledge for social change. Her success represents the power of *returning to the root* of African tradition.

Notes

1. In this article, I use the term mathematics education to describe a field of study that examines how students interact with curriculum and pedagogy that requires understanding of mathematics, statistics, and mathematized applications of science, social sciences, and other disciplines.
2. The teacher and students' identities have been protected by the use of pseudonyms.
3. State regulations require that 15 percent of the school population be enrolled in the program. Generally, 60-100 children are enrolled in the program at any one time.

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