Rethinking Mathematics

Web Resources
Race, Retrenchment, and the Reform of School Mathematics
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By William F. Tate

The teaching of mathematics needs to be connected to the lives and experiences of African-American students, thereby enabling them to take part fully in our democracy. Traditionally, schools have provided African-American students with few opportunities to connect mathematics to their lives and experiences. More than 60 years ago, historian Carter Woodson described this dilemma:

And even in the certitude of science or mathematics it has been unfortunate the that the approach to the Negro has been borrowed from a "foreign" method. For example, the teaching of arithmetic in the fifth grade in a backward county in Mississippi should mean one thing in the Negro school and a decidedly different thing in the white school. The Negro children, as a rule, come from the homes of tenants and peons who live to migrate annually from plantation to plantation, looking for light which they have never seen. The children from the homes of white planters and merchants live permanently in the midst of calculations, family budget, and the like, which enable them sometimes to learn more by contact than the Negro can acquire in school. Instead of teaching such Negro children less arithmetic, they should be taught much more of it than the white children, for the latter attend a graded school consolidated by free transportation when the Negroes go to one-room rented hovels to be taught without equipment and by incompetent teachers educated scarcely beyond the eighth grade.

One important implication of Woodson's argument is that mathematics instruction that is built on a student's life experience provides two mathematics learning environments-- within the school and outside the school. Unfortunately, the disciplines that undergrad mathematics education-- mathematics and psychology-- place great stress on objectivity and neutrality. As a result, school mathematics has been tacitly accepted as a colorblind discipline. Thus very little consideration is given to the cultural appropriateness of mathematics pedagogy.

In recent years mathematics textbooks have included pictures of African Americans, and some mathematics textbooks provide information about Africans and African Americans who have contributed to the development of the discipline of mathematics. These efforts represent progress and should be encouraged. Yet I doubt seriously if these efforts will prove sufficient to engender African American students in mathematics. I contend that connecting the pedagogy of mathematics to the lived realities of African American students is essential to creating equitable conditions in mathematics education.

THE CURRENT STATE OF AFFAIRS

What type of pedagogy must African American students negotiate have to be successful in school mathematics? Conventional mathematics pedagogy emphasizes whole-class instruction, with teachers modeling a method of solving problems and students listening to the explanation. This is typically followed by having the students work alone on a set of problems from a textbook or worksheet. The goal of this teacher-directed model of instruction is for students to produce correct responses to a narrowly prescribed problem. This type of mathematics pedagogy is consistent with several studies of mathematics instruction conducted in the 1970s.(3)

Unfortunately, this conventional mathematics pedagogy is exactly the kind of "foreign method" of teaching described by Woodson. Few, if any, attempts are made to build on the thinking and experiences of African American students. One important purpose of mathematics education is to prepare students to incorporate mathematical reasoning and communication into their everyday lives. However, conventional pedagogy has often persuaded students-- particularly African American students-- to consider school mathematics as a subject divorced from their everyday experiences and from their attempts to make sense of their world.(4)

Today, the "foreign" pedagogy delineated by Woodson continues in many different forms. For example, pedagogy for African American students is hampered by the following conditions of their schooling: 1) persistent tracking; 2) less access than other students to the best qualified teachers of mathematics, and 3) fewer opportunities to use technology in school mathematics.(5) Moreover, as the proportion of African American students in a school increases, the relative proportion of college-preparatory or advanced sections of mathematics decreases.(6)

What is the effect of the foreign pedagogy on African American students' thinking and achievement in mathematics? Recent data from the National Assessment of Educational Progress (NACP) indicate that African Americans, across the grade levels tested, scored significantly better on portions of the test related to factual knowledge and basic computational skills than they did in 1978 or in 1982 (7) However, no growth was evident on portions of the test that it assessed more advanced levels of mathematical reasoning. Should we be surprised at these findings? Walter Secada commented on the consistency of the IAEF findings with the pedagogical focus of the previous decade:

Indeed, if we agree that we 1970's and 1980's were times when educational policy was predicated on mastery of basic skills, we could read these data as telling a success story: Insofar as we had set a national goal-- the acquisition of basic skills-- we moved in the direction of its attainment. African Americans did become proficient in their mastery of low-level basic skills. Alternately, we might read this as a story of incomplete success. Insofar as basic computation skills are deemed insufficient for the knowledge and mastery of mathematics, these data document how much father we have to go.(8)
RACE, REFORM, AND RETRENCHMENT

What role should the reform of school mathematics play in changing this story of incomplete success? Recent reform documents published by the National Council of Teachers of Mathematics have called for a new vision of mathematics pedagogy.\(^{(9)}\) For example, *Professional Standards for Teaching Mathematics* commends that all mathematics teachers know the following:

* how students’ linguistic, ethnic, racial, gender, and socioeconomic background influence their learning of mathematics; and
* the role of mathematics in society and culture, the contribution of various cultures to the advancement of mathematics and the relationship of school mathematics to other subjects and realistic application.\(^{(10)}\)

Despite these recommendations, mathematics pedagogy built on the lives and experiences of African American students must overcome many formidable barriers if it is to make its way into our classrooms. Many scholars argue that the curriculum and pedagogy of mathematics have been and continue to be connected to Eurocentric precept that exclude the African American experience.\(^{(11)}\) George Joseph states:

> The progress of Europe and its cultural dependencies [including the United States of America] during the last 400 years if perceived by many as inextricably— and even causally— linked with the rapid growth of science and technology. So in the minds of many, scientific progress becomes a uniquely European phenomenon, to be emulated only by following the European path of social and scientific development.\(^{(12)}\)

Joseph’s remarks are germane to the current debate involving equity in the reform of school mathematics. Rather than address the problem of how to connect mathematics to the lives of African American students, many advocates of reform have argued that African American students warrant better treatment in mathematics classrooms on the grounds of national economic interest and global competition.\(^{(13)}\) For example, a report from the Carnegie Commission on Science, Technology, and Government states:

> The national interest is strongly bound up in the ability of Americans to compete technologically. This requires not only an adequate supply of scientific and technical professionals but a work force able to solve problems and use tools of a knowledge-intensive economy. All young people, including the non-college bound, the disadvantaged, and young women, must be given the opportunity to become competent in science and mathematics.\(^{(14)}\)

Arguments based on the need to prepare workers for life in a global economy, while persuasive to the public, generally overlook the problems facing African American students in many school settings. Michael Apple suggests that these appeals to economic self-interest are attempts to persuade educators to compromise their beliefs about individual human rights because of the current fierce global competition for economic prosperity.\(^{(15)}\) The tension between mathematics pedagogy that is connected to the experiences of African American students (an individual human right) and the national economic interest is real and can be a barrier preventing educators from seeking equity in mathematics education.

The documents that have spawned a recent movement to reform mathematics education have called for a new era of "mathematics for all." These documents have embraced the idea of improving the mathematics performance of African American students in our nation’s urban centers, but achieving this objective will require a blueprint. As Larry Cuban warned several years ago, "Unless policy makers and practitioners begin to consider how problems involving schools are framed, they will continue to lunge for quick solutions without considering the fit between the solution and the problem."\(^{(16)}\)

The current reform movement in mathematics education has been framed within a discussion of national economic interests. This focus raises questions about the ability of current reforms to generate interest in pedagogical practices that go beyond those intended to yield gains for the national economy. I contend that educators and policy makers who are leading the mathematics reform movement should address two questions related to the problems facing African American students in mathematics classrooms across the U.S. First, should school districts support (and teachers provide) mathematics teaching built on the experiences and lives of African American students? Second, should the focus of mathematics teaching be to prepare African American students to participate in the national economy or in our democracy? Both questions are extremely complex and probably do not have one right answer. However, I will devote the remainder of my discussion to examples that help illuminate the urgency of these questions.

“CENTRICITY” AND MATHEMATICS PEDAGOGY

I have argued that one barrier to an equitable mathematics education for African American students is the failure to "center" them in the process of knowledge acquisition and to build on their cultural and community experiences. Molefi Asante defines the concept of *centricity* as "a perspective that involves locating students within the context of their own cultural references so that they can relate socially and psychologically to other cultural perspectives." The concept of centricity can be applied to any culture. "For the white students in America, Asante continues, this is easy because almost all the experiences discussed in American classrooms are approached from the standpoint of white perspectives and history."\(^{(17)}\)

*The student teacher was trying to center the students in the process of knowledge acquisition, through the use of a cultural construct.*

The idea that mathematics pedagogy should be built on the experiences of the student is undergoing a resurgence in the current reform movement. Yet very little has been written about building a mathematics program centered on the thinking and experiences of African American children.\(^{(18)}\) I offer two examples of the influence of mathematics pedagogy that has not been constructed to center the African American child.

The first example is based on an experience with a student teacher at my university. She provided her class with the following problem: Joe has five pumpkin pies. Karen has six pumpkin pies. How many pumpkin pies do Karen and Joe have all together?

This problem was written on the chalkboard when I entered the classroom. Five children were seated in the room— one African
American and four whites. This was a second-grade class at the beginning of a school year. These five students were provided separate mathematics instruction so that they could receive individualized attention to help improve their performance. The four white children were busy using manipulatives and appeared excited about the process of solving the problem. On the other hand, the African American child was not engaged in any outward activity. He was very quiet and appeared uninterested.

I asked the student teacher about the African American student's behavior. She replied, "Mark does not like math. (19) I don't understand why; he's not a bad kid." Curious, I inquired about the discussion that led to the "pumpkin pie" math problem. The student teacher responded, "I used pumpkin pie as the object to be added because Thanksgiving is in two weeks." She went on to say that she wanted to motivate the students to solve a problem related to their holiday experience. In essence, she was trying to center the students in the process of knowledge acquisition. She was using a cultural construct--Thanksgiving pumpkin pie--as the means of centering her students. Yet her attempt to center the African American student was unsuccessful.

I asked the student teacher if she thought every family ate pumpkin pie on Thanksgiving. Her response was "probably," I asked her to ask each of the five children in the class. She discovered that pumpkin pie was indeed a Thanksgiving ritual in the homes of the white children. For the African American child, however, sweet potato pie was the dessert of the day. Thus the background discussion that led to the problem was "foreign" to this student.

The student teacher had worked to provide the children in her class with what she thought was a problem centered in the context of their lives. Yet the problem reflected the default position of an idealized white middle-class reality. The mathematics problem and her pedagogy were unwittingly constructed to be the property of white children.

Understand my point here. I am not suggesting that all African American families celebrate Thanksgiving in the same way or that all white families do either. Rather, I contend that the default position of mathematics curriculum, assessment, and pedagogy is often more closely aligned with the idealized experience of the white middle class. Moreover, this reality is subtle and often difficult to diagnose. (20) The diagnosis is difficult because, traditionally, mathematics has been viewed as neutral and objective. A group of teachers from an urban middle school discovered this very point when a large number of students at their predominantly African American school responded "strangely" to an assessment item on a district wide mathematics test. (21) The basic structure of the test item was as follows: It costs $1.50 each way to ride the bus between home and work. A weekly pass is $16. Which is the better deal, paying the daily fare or buying the weekly pass?

The district's test designers constructed the problem on the assumption that students who solved the problem correctly would choose to pay the daily fare. Implicit in the design of the test item is the notion that all people work five days a week. It is also assumed that the employee has only one job.

Yet these assumptions are not consistent with the daily lives and realities of many African American students. (22) Thus it should not have been shocking that a large percentage of the students in this particular middle school thought that "buying the weekly pass" was the better option. When school officials questioned the students about their responses, they found that many of the students had centered themselves in the solution process. These students converted the "neutral" context of the problem into their own property. For instance, the students commented on the fact that more than one family member could use a weekly pass. They also mentioned the option of using the weekly pass on Saturdays and Sundays. In the families of many African American students, the financial providers hold several jobs--both on weekdays and on weekends. For these students, choosing the weekly pass is economically appropriate and mathematically logical.

Taking a "centric" perspective would enable mathematics teachers to expect their students' responses to be linked to the specific details of the students' lives. Unfortunately, African American students who center their lives and experiences within the process of acquiring knowledge about mathematics risk being put down for focusing on "extraneous matters." (23) As a result, many African American students view mathematics as a subject appropriate only for white males, and they fail to see the relevance and usefulness of the discipline. (24)

I submit that failing to provide African American students with curriculum, instruction, and assessment that are centered on their experiences, culture, and traditions is a major obstacle to providing them with an empowering mathematical experience. (25) A closer look through a centric framework reveals important details about the Eurocentric terrain that the children in this urban middle school had to negotiate in order to claim ownership of the mathematics presented on their test. First, the students had to understand that the mode of representation reflected the experiences of a traditional white middle class family. Second, the students had to understand the mathematics involved in solving the test item using the white middle class as a frame to guide their problem solving. This dual consciousness was required if the students were to "succeed" according to the Eurocentric assumptions of the test designers.

Is the first level of consciousness fair or empowering to African American students whose experiences are not those of the white middle class? William Harvey provides what I consider an appropriate response to this question.

The advocacy of the values and lifestyles of the dominant white culture is not and cannot be psychologically beneficial to Blacks. The dominant cultural value system, ant that of the school, admonishes Black students for being what they are while physical and social reality prevents them from being anything else. (26)

In order to take advantage of the diversity in a single classroom, a mathematics teacher's pedagogy should try to provide students with opportunities to solve problems using their experiences. (27) Of course, the mathematical processes used to solve problems should be consistent with the contexts of students' lives. Furthermore, mathematics teachers working from a centric perspective would endorse having their students solve the same problem from the perspective of different members of the class, school, and society. This approach is consistent with the methods of successful teachers of African American children. Gloria Ladson Billings found that these teachers looked to connect students' knowledge of self with broader social and political realities. (28)

CONFLICT, DEMOCRACY AND PEDAGOGY

A second barrier to providing an equitable mathematics education for African American students is the failure to prepare them for the conflicts of democracy. Traditionally, mathematics education has been connected to issues of national economic survival rather than to the development of democratic citizenship through critical thinking in mathematics. (29) The latter involves helping students engage in mathematical thinking that is connected to the students social and political contexts. The intent of this pedagogy is twofold. First, students are being prepared to take an active role in our democracy. Second, students are provided important insight into and understanding of the role of mathematics within the democratic system of governance.

Until recently, embedding mathematics pedagogy within social and political contexts was not a serious consideration in
mathematics education. The act of counting was viewed as a neutral exercise, unconnected to politics or society. Yet when do we ever count just for the sake of counting? Only in school do we count without a social purpose of some kind. Outside of school, mathematics is used to advance or block a particular agenda. However, mathematics curriculum and pedagogy rarely prepare the African American student to engage in authentic contexts of democracy.

There is a growing consensus among scholars that knowledge is constructed through the interaction of the mind and authentic experiences.\(^{(30)}\) For example, John Seely Brown and his colleagues have theorized that in-school knowledge is acquired by working alone, memorizing static rules for well-defined problem settings.\(^{(31)}\) Acquiring knowledge of mathematics in this type of setting makes it difficult for students to use mathematics as a tool by working from personal (i.e., centric) meaning. The activity, context, and culture of the learning environment are reference points for the retrieval, interpretation, and use of mathematical knowledge. A child’s construction of meaning is a result of social interactions—the negotiation of understanding that derives from engaging in real activities of the culture.

Perhaps an example of the work of a practicing teacher will illustrate how mathematics pedagogy can build on the personal and social perspectives. The “War Room” is occupied by Sandra Mason’s students. The 10 students in her class have targeted 25 problems that they feel are negatively affirming their community, including the 13 liquor stores within a 1,000-foot radius of the school. Each member of the class has been greatly influenced by the presence of the liquor stores (i.e., the problem is centric). For example, one female student commented, “We pass by drunks asking us for money. We keep going but they harass us and tell us to come here.”

**Our highly technological society requires that all students be prepared to use mathematics to defend their rights.**

The students have found that the disproportionate number of liquor stores of their community is a function of local legislation.\(^{(32)}\) To resolve the conflict between the local liquor laws and their negative experiences, the students have formulated and proposed mathematically based economic incentives to get liquor stores to relocate away from the school.

For Mason’s students, mathematics is more than just numbers shorn of context (i.e., in-school knowledge). Instead, mathematics is embedded within the culture of their daily struggles. These students are learning to use mathematics to support their political positions. For example, the students in this class have mastered the relationship between media sound bites and mathematics, because Mason has prepared them to ask and answer several questions, using mathematics, that will be important in launching arguments for their position or countering the arguments of their opponents. What methods of mathematical analysis will best support our position? What variables should be included in our analysis to strengthen our position? How can we minimize the influence of variables that may weaken our position? Will percentages or raw numbers make a more striking impression?

These questions are integral aspects of “mathematizing” in our society.\(^{(33)}\) Yet such questions are rarely found in the sources that guide the development of mathematics reform. An African American child will confront similar “mathematized” renditions of social reality every day. For instance, the battle over the appropriate use of racial categories in the U.S. Census is still being waged. The struggle for control of the liquor stores for the Census is one of the most technologically complex and socially relevant debates of our time.\(^{(34)}\) When will African American and other children encounter such a debate in school mathematics? Will the traditional curriculum and pedagogy of mathematics prepare our children to ask the types of questions that are necessary for participation in a democracy?

I propose the need for a mathanatics curriculum and pedagogy that recognize mathematical production as a function of conflict on two levels. First, like all communities, the mathematics community is governed by stated rules and a covert value system.\(^{(35)}\) Within this community, individuals and groups of mathematicians have a significant history of struggle over that is deemed appropriate knowledge for the discipline. The many other issues over which battles have raged within this community include the interpretation of data, credit for discovering ideas, and censorship. The very nature of mathematical production involves conflict. Yet traditional mathematics classrooms are structured to rank students’ understanding of a body of data, credit for discovering ideas, and censorship. The activity, context, and social (conflict) perspectives would lead mathematics teachers to explore a variety of questions with their classes. What variables are included in this model? How do variables such as gender, family history, and income influence a patient’s chances of receiving life support services? Does being an African American male lower a patient’s chances of receiving life support services, since in economic terms, there are two conditions: What agenda is being maximized by a given example of mathematizing? Will the use of mathematical categories, renditions of social conflict will necessarily ensue.

In economic terms, there are two conditions at work when issues are mathematized. First, situations are mathematized in order to maximize the return on the information that is being analyzed. Thus mathematics pedagogy should seek to prepare students to answer the following question: What agenda is being maximized by a given example of mathematizing?

For example, hospitals are experimenting with computer systems that can calculate the probability of surviving an illness, based on specific variables about the patient.\(^{(36)}\) This development provides teachers with an opportunity to explore with their students a mathematized situation. For instance, decisions to place patients on life support systems will be influenced by the mathematical models used by the computer. Mathematizing the decision to place a patient on life support—under the banner of optimizing system use, minimizing hospital cost, and maximizing profit—could result in discriminatory practices. Adapting the personal (centric) and social (conflict) perspectives would lead mathematics teachers to explore a variety of questions with their classes. What variables are included in this model? How do variables such as gender, family history, and income influence a patient’s chances of receiving life support services? Does being an African American male lower a patient’s chances of receiving life support services, since comparatively speaking, African American males have a shorter life expectancy? In essence, does the computerized mathematical model reinforce existing survival rates?

The second reason situations are mathematized is to minimize the risk of successful challenges to the decision-making process: How many students leave school with enough knowledge and practice to challenge the use of mathematics in society? Thus far, it has been our experience that it is more difficult for our students to counter with their own mathematically based arguments—a disproportionate number of whom are African Americans.\(^{(37)}\) If students learn in school to analyze and critique mathematized situations, such as the hospital computer system described above, they will be prepared for public discussions about the development and implementation of the new models that are used in social decision making. Such preparation is radically different from merely preparing students to add, subtract, multiply, and divide accurately. Our highly technological society requires that all students, whether African American or other students, be prepared to use mathematics to defend their rights. The curriculum and pedagogy of mathematics should support this objective.

I have argued that African American students should be provided a mathematics pedagogy that is built on their cultural experiences. Furthermore, I contend that this mathematics pedagogy should prepare African Americans and others to participate in our democracy. Traditionally, these two pedagogical recommendations have not been part of the “mainstream” discourse on school mathematics. More recently, standards for school mathematics reform have called for pedagogy that recognizes these objectives.
However, research suggests that many educators will most likely implement only those mathematics standards that are consistent with their own beliefs about appropriate mathematics pedagogy.\(^{(38)}\)

Will teachers and other educators view as important the dual need to build on students’ personal experiences and to empower them to function in a democracy? Will they move to change current practice? Woodson provides an appropriate ending to this discussion:

In the first place, we must bear in mind that the Negro has never been educated. He has merely been informed about things which he has not been permitted to do. The Negroes have been shoved out of the regular schools through the rear door into the obscurity of the backyard and told to imitate others whom they see from afar, or they have been permitted in some places to come into the public schools to see how others educate themselves. The program for the uplift of the Negro in this country must be based upon the scientific study of the Negro from within to develop in him the power to do for himself.\(^{(39)}\)

The prospect of a new beginning for mathematics education rests with the ability of mathematics teachers to provide pedagogy that builds and expands on the thinking and experiences of African American students. Moreover, this pedagogy should focus on preparing these students to function within our democracy.

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