

Mathematics Standards, Cultural Styles, and Learning Preferences

The Plight and the Promise of African American Students

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Evidence of disparities in mathematics achievement continues to show up in students' assessment scores, course enrollment patterns, and allocation of resources in American schools. When examining the achievement disparities and the achievement levels of African American students, as well as other ethnic groups, researchers are becoming increasingly dismayed. In this article, I posit that African American students receive mathematics instruction that is not consistent with mathematics education reform; furthermore, the mathematics instruction that many African American students receive is in opposition to their cultural styles and learning preferences. I will summarize the National Assessment of Educational Progress (NAEP) mathematics assessment literature as it pertains to eighth-grade African American students and describe the cultural styles and learning preferences of these students. I will compare the cultural styles and learning preferences of African American students to the National Council of Teachers of Mathematics (NCTM) Process Standards. This comparison will suggest that if African American students receive mathematics instruction recommended by those standards, such instruction will complement their cultural styles and learning preferences. This complementation should positively influence the mathematics achievement of African American students.

Disparities in Mathematics Achievement and Instruction

The NAEP mathematics assessment gauges student mathematics achievement in grades four, eight, and twelve and is an ongoing national assessment of mathematics achievement in the United States. It provides

information about what students know and can do in mathematics. It also provides factors that might influence students' performance. NAEP data have been used to show that several factors, such as socioeconomic status, school policies, allocation of human and material resources, and classroom instructional practices, may account for performance disparities (Oakes 1990; Secada 1992; Tate 1997). NAEP results show that, as a group, African American students typically score below their peers in all mathematics content areas. Moreover, these achievement differences grow as topics increase in complexity (Anick, Carpenter, and Smith 1981; Burton 1984; Dossey et al. 1988; Johnson 1984; Johnson 1989; Jones, Burton, and Davenport 1984; Strutchens and Silver 2000).

Although there have been some achievement gains among African American students since 1980, these improvements have occurred mostly on those sections related to basic skills (Martin 2000). On the 1996 NAEP mathematics assessment, 4 percent of African American students in grade eight scored at or above the proficient level, 24 percent performed at the basic level, and 72 percent performed below the basic level (Braswell et al. 2001). Although the mathematics scores for eighth grade African American students did increase from 1996 to 2000, that increase was not a significant one. On the 2000 NAEP mathematics assessment, 6 percent of African American students in grade eight achieved at or above the proficient level, 27 percent performed at the basic level, and 68 percent performed below the basic level (Braswell et al. 2001).

Although African American students at grade eight have made gains in mathematic performance since 1990, the large gaps between African American and

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white students' achievement in this area has remained relatively unchanged (Braswell et al. 2001). The gap between these groups is greater in 2000 than it was in 1990. In 1990, white students achieved thirty-two points higher on the NAEP mathematics assessment than African American students; forty points higher in 1992; thirty-nine points higher in 1996; and thirty-nine points higher in 2000. Lubienski's (2001) secondary analysis of the 1990 and 1996 NAEP mathematics assessment indicates that, although class is a factor in the achievement gap between African American and white students, race primarily accounts for the differences in mathematics achievement among these groups. Lubienski (2001) reported that, in both 1990 and 1996, white students in the lowest socioeconomic subgroup scored equal to or higher than African American students in the highest socioeconomic subgroup. On the 1996 NAEP mathematics assessment, African American students in the highest socioeconomic subgroup scored a significant twenty-two points lower than white students in the lowest socioeconomic subgroup (Lubienski 2001).

African American students' mathematics achievement levels are indicative of the instruction that they receive. Data collected on teachers' instructional practices indicate differences between African American students and their peers. The NAEP data suggest that most African American students are not experiencing instructional practices consistent with the recommendations suggested by the National Council of Teachers of Mathematics (NCTM), whereas more white students are experiencing NCTM standards-based instruction (Lubienski 2001). African American students in grade eight reported that their teachers were less likely to emphasize reasoning and nonroutine problem solving when compared to national responses (Strutchens and Silver 2000). Teachers of African American students reported having as much access to technology as those of white students; however, there are differences in how the technology is used. African American students were more likely to use computers for drill and practice or games, whereas their white counterparts were more likely to use computers for simulations, demonstrations, or application of concepts (Lubienski 2001). Teachers of African American students were more likely to use worksheets on a daily basis than teachers of white students (Strutchens and Silver 2000). Fifty-eight percent of African American eighth grade students agreed that mathematics is mostly memorizing facts, which is significantly more than the 40 percent reporting nationally (Strutchens and Silver 2000). Furthermore, African American students were more likely to have teachers who reported no use of calculators in mathematics class and to have teachers who reported not allowing calculator use on assessments. Lubienski (2001) reported that the gaps between African Ameri-

can and white students in technology use and instructional practices are not attributed to socioeconomic differences, but to race.

African American Cultural Style

Equity in school mathematics is the understanding and appreciation of the various cultures from which the students come, the development of knowledge within those cultural frameworks, and an understanding of mathematics within varying cultural frameworks (Secada 2000). Tate (1995) contended that Carter G. Woodson provided a framework to begin the rethinking and reconstructing of mathematics education that would be equitable for African American students. Woodson's (1933/1999) approach to mathematics education is built on African American culture, experiences, and traditions. Mathematics education must consider the use of dynamic strategies for understanding the thinking and experiences of African American students if it is to be equitable for them.

Because race and ethnicity are categories laden with cultural beliefs and biases, it is important to consider cultural orientations when studying the perspectives of African Americans (Moody 1998). Although African Americans are a part of every social strata, and their social context influences their experiences and how they view the world, their cultural knowledge, expressions, and understandings share features with African Americans across all socioeconomic and geographical boundaries (Ladson-Billings 1997). African Americans have a distinct culture based on their inability to participate fully in the mainstream culture; this experiential wisdom provides a unique outlook on life that cannot be shared by non-African Americans (Shade 1997b).

Boykin (1986) used his research on African American children's socialization, African American communities, and the work of other scholars to identify nine interrelated but distinct dimensions of the African American cultural experience. The nine dimensions are:

1. Spirituality is the conviction that nonmaterial forces influence people's everyday lives.
2. Harmony addresses the notion that people are interrelated with other elements; humankind and nature are harmoniously conjoined.
3. Movement emphasizes the interweaving of pattern, rhythm, pulsation, music, and dance.
4. Verve is a propensity for relatively high levels of stimulation and to action that is energetic and lively.
5. Affect focuses on emotions, feelings, and nurturing.
6. Communalism is an awareness that social bonds and responsibilities transcend individual privileges.
7. Expressive individualism is the cultivation of a distinct personality and a proclivity for spontaneous, genuine personal expression. There is a preference for novelty, freedom, and personal distinctiveness;

the development of improvisations in music and styles of clothing show this distinctiveness.

8. A social time perspective is an orientation in which time is treated as passing through a social space rather than a material one; there is a tendency to approximate space, time, and numbers rather than stick to accuracy.
9. Oral tradition is a preference for oral modes of communication in which both speaking and listening are treated as performances; there is a tendency toward proficiency in nonverbal communications (Boykin and Toms 1985, 41).

The African American experience is not widely understood by mainstream society; thus the two cultural frames of reference—the African American frame and the mainstream frame—are sharply at odds (Boykin 1986). The African American perspective emphasizes spiritualism and stresses harmony with nature, whereas the mainstream perspective emphasizes materialism and stresses mastery over nature. An orientation toward expressive movement contrasts with a compressive orientation toward impulse control. The African American cultural frame emphasizes interconnectedness, whereas the mainstream frame puts a premium on separateness. An event orientation toward time contrasts to a clock orientation toward time; an oral based culture contrasts to one based on print. In the African American culture, there is interplay between expressive individualism and communalism, so that possessions belong to the community at large and uniqueness is valued. The mainstream cultural frame juxtaposes possessive individualism and an egalitarian conformity, whereas private property is an alienable right and sameness is valued. The African American cultural frame has a person-to-person emphasis with a personal orientation toward objects; the mainstream frame has a person-to-object emphasis with an objective orientation toward people (Boykin 1986). The African American cultural style is not static; individuals vary in the strengths of their cultural identities.

Having an understanding of research associated with the African American cultural style can help increase student learning when pedagogy is compatible with the cultural style of African American learners (Bennett 2001). However, educators and researchers should be cautious of ethnic stereotyping. Although African Americans share common cultural, historical, and social experiences, not all cultural characteristics uniformly apply to all African Americans. When used properly, knowledge about African American cultural style provides educators with a means for interpreting students' thoughts, feelings, and actions, while raising expectations for student success (Bennett 2001).

Learning Preference of African American Students

If we accept that African American culture is a significant socializing force for African American children and that culture is learned, then it would be essential to investigate the nature of teaching and learning preferences associated with the African American culture. From this investigation, we can determine that the learning preference African American children are most commonly exposed to and may prefer is related to their cultural style. To maximize learning potential, teachers must create some continuity between the learning preferences of African American students and the culture of schools.

Because African American students have a preference toward a relational style of learning (Ladson-Billings 1997; Shade 1997a; Stiff and Harvey 1988), they approach object relations in a global manner, with less competence in analytical functions (Shade 1997a). Relational learning preference is characterized as freedom of movement, variation, creativity, divergent thinking, inductive reasoning, and focus on people. However, schools are structured to advantage students whose learning preference is analytical (Hale-Benson 1986; Hilliard 1976; Ladson-Billings 1997; Shade 1997a). Learners having an analytical learning preference approach object relations in a logical diagnostic fashion with the ability to discern objects as discrete from their context (Shade 1997a). Analytical learners have a tendency toward impersonal preferences in social encounters. The discontinuity between the learning preferences of African Americans and the culture of schools (i.e., instructional methodologies and style) leads to errors in determining students intellectual potential, learning abilities, and communication abilities. This discontinuity leads educators to lower expectations, which ultimately affects achievement.

Shade (1997a) described the African American learning preference as an aggregate of holistic, relational, and field-dependent learning styles. Holistic learners seek to synthesize divergent experiences to obtain the essence of experiences. They thrive on content tied to a larger whole and perceive cause and effect as separate entities. The kinesthetic mode is the primary mode of information induction; thus concreteness is needed to facilitate new learning (Shade 1997a). Field-dependent learners need cues from the environment, prefer external structure, are people oriented, are intuitive thinkers, and remember material in a social context (Shade 1997a). African American learners use concrete imagery as a means of reckoning reality. They draw on their daily experiences to facilitate learning. African American learners classify ideas, items, and experiences based on how things relate to each other. In addition, African American learners prefer experi-

mentation, improvisation, and harmonious interaction with others and the environment (Shade 1997a).

Understanding how African American students learn is an important variable of effective teaching; a mathematics instructor may find that this understanding may lead to engaging the students in areas outside of mathematics, such as having them write autobiographies and discussing their interests (Ladson-Billings 1997). A cultural-based perspective to teaching mathematics recognizes that within the African American culture there is an affinity for rhythm and pattern (Ladson-Billings 1997). Jazz, gospel music, rap, poetry, basketball, sermonizing, dance, and fashion all reflect African American influences of rhythm and pattern. However, these influences are rarely connected to any mathematical structures. Not all cultural expressions should be mathematized, but it is important to help students see the connections between mathematics and their contextual and cultural ways of knowing. Furthermore, by mathematizing some African American cultural expressions, students of all cultures can recognize the contributions that the African American culture brings to mathematical thinking and learning. By acknowledging cultural expressions in an academic setting, teachers can help African American students feel empowered to become academically successful.

NCTM Process Standards

The NCTM has had the most profound influence on reform in mathematics education with its publications (NCTM 1989; NCTM 1991; NCTM 2000). The documents recommend standards for the mathematics curriculum in grades pre-K to 12, professional standards for mathematics educators, and assessment standards for evaluating the quality of both student achievement and curriculum. The NCTM documents acknowledge that students' cultural experiences, social background, and gender affect mathematics teaching and learning. In addition, they recognize that African American students have been underserved in school mathematics.

Directly stated, the recommendations proposed by the NCTM Process Standards complement the learning preferences of African American students. The NCTM Process Standards are: problem solving, reasoning and proof, communication, connections, and representation (NCTM 2000). The five NCTM Process Standards focus on how students should learn and use mathematics.

The Problem Solving Standard

The problem solving standard is consistent with the learning preferences of African American learners because it recommends that students build mathematical knowledge through problem solving, solve problems in context, apply and adapt a variety of problem solving strategies, and reflect on the problem-solving process. This standard supports the notion that African

American learners should have opportunities to experience mathematical problem solving in a social context and to use various strategies to solve problems. By experiencing problem solving in a social context, African American learners can understand the relevance of mathematics. African American learners should be allowed to use creativity, experimentation, and improvisation to test, monitor, and reflect on the problem-solving process. Thereby, African American learners develop metacognitive strategies, which broaden their pool of problem solving strategies.

The Reasoning and Proof Standard

The reasoning and proof standard suggests that students make and investigate conjectures, develop and evaluate mathematical arguments, and select and use various types of reasoning and methods of proof (NCTM 2000). These suggestions support experimentation, expressive individualism, divergent thinking, and a holistic perspective, which are preferred by African American learners. Expressive individualism refers to cultivating a distinctive personality. By employing expressive individualism, African American learners can use their preference toward divergent thinking to develop mathematical arguments. In addition, by having a holistic perspective, they can investigate mathematical conjectures as they relate to content tied to a larger whole.

The Communication Standard

The communication standard proposes that students organize and consolidate their mathematics thinking, coherently communicate their mathematical ideas to others, analyze and evaluate the mathematical thinking and strategies of others, and use the language of mathematics to express mathematical ideas (NCTM 2000). Because African American learners have a person-to-person orientation, preference toward oral expressions, social and affective emphasis, and are attuned to nonverbal communication, the communication standard corresponds well with their cultural styles and learning preferences. African American learners should have opportunities to discuss and share their mathematical thinking. The teacher can monitor students' use of oral reasoning and justifications, assist them in organizing their thoughts, and help them develop critical thinking and problem-solving skills. In addition, teachers can model writing in mathematics as an equally important approach. As a result, students can make connections between expressing mathematical thoughts orally and graphemically.

The Connections Standard

The connections standard recommends that students interconnect mathematical ideas to understand how they build on one another to produce a coherent whole

(NCTM 2000). In addition, the connections standard recommends a holistic view of mathematics that contextualizes mathematical ideas and concepts. Shade (1997a) observed that African American learners need an understanding of the interconnectedness and interdependence among ideas, items, and experiences for optimal learning to exist. In other words, teachers need to provide many experiences that are personalized, contextualized, and authentic. Consequently, teachers should consider interweaving mathematics with patterns, rhythm, pulsation, music, and movement—all part of the African American cultural experience.

The Representation Standard

The representation standard suggests that students create and use representations to organize, record, and communicate mathematical ideas; select, apply, and translate among mathematical representations to solve problems; and use presentation to model and interpret physical, social, and mathematical phenomena (NCTM 2000). The representation standard corresponds with African American learners' preference for concrete imagery, creativity, verve, and divergent thinking. Because African American learners have a propensity for verve, mathematics learning and teaching should be stimulating and interesting, as well as offer opportunities for hands-on experiences that promote interactivity. Mathematics can be represented in multiple ways: it can be viewed through students acting out problem solving situations, it can be talked about, listened to, written about, graphically represented, and represented by building models. African American learners' mathematical experiences must include opportunities that allow them to use mathematics creatively.

Evidence

Evidence suggests that classrooms that use standards-based practices positively influence the mathematics achievement of African American students. These classes use the NCTM Process Standards as a mechanism to facilitate the teaching and learning of mathematics content. Researchers who have studied the impact of standards-based practices report that students who learn mathematics using standard-based curricula outperform students who use traditional mathematics curricula. The following research focuses on the achievement of African American students who learned mathematics in a standards-based classroom.

In 2000, the ARC Center, located in Lexington, Massachusetts, at the Consortium for Mathematics and Its Applications (COMAP), did a large-scale study of the effects of three standards-based curricula on third-, fourth-, and fifth-grade students' performance on state-mandated standardized tests in Massachusetts, Illinois, and Washington State (ARC 2003). Researchers compared the achievement of students learning mathemat-

ics using standards-based curricula with matched comparison students not using any of the three curricula. Students were compared in the following content areas: computation, measurement, geometry, probability and statistics, algebra, and total mathematics. With the exception of probability and statistics, results showed that the average scores of African American students using the standards-based curricula were significantly higher than the average scores of African American students in the matched comparison schools.

In Philadelphia, where students are predominately African American, a five-year study compared students learning mathematics using the standards-based curriculum, Interactive Mathematics Program, to students learning mathematics using a nonstandards-based curriculum (Merlino and Wolff 2001). Students using standards-based curriculum consistently outperformed those who were taught using nonstandards-based curriculum.

Pittsburgh public schools implemented a systemic change to standards-based mathematics in the early 1990s (Schoenfeld 2002). Briars and Resnick (2000) identified strong-implementation schools of the standards-based curricula and weak-implementation schools. They found that both African American and white students at strong-implementation schools outperformed their peers at weak-implementation schools on the New Standards Mathematics exam. In addition, there was no significant difference between African American and white students' scores on the New Standards Mathematics exam at strong-implementation schools.

Conclusion

At the beginning of this article, I posited that African American students do not typically receive mathematics instruction consistent with mathematics education reform. It seems clear that if African American students experience instructional practices recommended by the NCTM, such practices would be consistent with their learning preferences and would perhaps bolster their achievement in mathematics. Of course, student achievement is affected by many factors. Several factors interact in complex ways that effect the mathematics learning of African American students. Tracking policies, access to high level mathematics courses, teachers' beliefs about students, assessment, instructional practices, availability of resources, and students' attitudes and beliefs about mathematics are factors that must be considered when looking at variance in achievement levels. However, teachers can mediate many of these factors by developing an understanding of African American cultural styles and learning preferences, and by using the NCTM Process Standards as a mechanism for helping all students acquire mathematical knowledge.

Key words: mathematics, standards, African Americans, achievement, equity

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