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Supporting African American Students' Learning of Mathematics: A Problem of Practice

Kara Jackson[1] and Jonee Wilson[2]

Abstract

This article reports on a review of the mathematics education research literature 1989-May 2011 specific to K-12 African American students' opportunities to learn mathematics. Although we identify important developments in the literature, we conclude that the existing research base generally remains at the level of broad principles or orientations to teaching and is therefore inadequate for specifying forms of instructional practice that support African American students' participation in rigorous mathematical activity. We suggest a research agenda focused on specifying forms of practice that are empirically shown to support African American students' learning of mathematics and development of productive mathematical identities.

Keyword

African American students, mathematics, teacher development

In this article, we report on our review of the mathematics education research literature specific to supporting African American students' (K-12) opportunities to learn mathematics. Our motivation for conducting this review arose

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out of hundreds of interviews with middle-grades mathematics teachers, mathematics coaches, principals, and district leaders in four large urban districts in the United States, in which educators repeatedly described similar sentiments to Ms. Mackey.[1]

> Ms. Mackey: The principal and [the math coach] talk about targeting the African American children because . . . all over the United States they are performing lower than even Hispanic or White [students] . . .
> Interviewer: What kinds of support [have the principal and math coach] been trying to offer you to deal with that?
> Ms. Mackey: . . . I don't know . . . We have [grade-level] teams now this year so . . . in our team times, we're tutoring so we take 5 students twice a week and tutor them. . . . Honestly nobody seems to know exactly what to do to [help the African American students] learn better. (Interview with middle-grades mathematics teacher, January 31, 2008)

Teachers like Ms. Mackey were acutely aware of the need to educate African American students better in mathematics but struggled to identify *how* to do so. Most strategies that educators reported could be best characterized as tinkering around the edges of instruction (e.g., tutoring, providing a second mathematics class). Similarly, teachers reported little to no professional development or other school-based supports focused on supporting African American students in mathematics. At best, teachers reported engaging in "book studies" with their colleagues focused on changing perceptions of African American students or content-free professional development in culturally relevant pedagogy; although the book studies and professional development sessions were well intentioned, teachers reported they were no better able to support their African American students in mathematics instruction.

These findings led us to ask the following question: Since 1989 (the advent of *Standards*-based reform in mathematics in the United States), what does mathematics education research tell us about how to support African American students' substantial participation in classroom mathematics instruction aimed at rigorous learning goals?[2] In 1984, mathematics educator Martin Johnson asked a similar question of the literature and reported his findings in the *Journal for Research in Mathematics Education* in an article titled "Blacks in Mathematics: A Status Report." He reported a paucity of research focused on the instructional support of Black students and put forth the following:

> Research programs should be begun immediately to address [the underrepresentation of blacks in advanced mathematics and their underachievement on mathematics tests], including a study of the learning environment of the mathematics classroom. *Careful investigation is urgently needed into what teachers do, how they interact with black students, and the effects of this interaction on students' performance*. (M. L. Johnson, 1984, p. 150, emphasis added)

In many ways, our review picks up where Martin Johnson left off. We report on developments in mathematics education research in this area over the past two decades. We argue that, although there have been advances in this area, Martin Johnson's call for research focused on specifying instructional practice in 1984 still stands (see also Martin, 2009a).

Our review is organized as follows. We first describe our theoretical framework, which is generated, in part, from the literature we reviewed that conceptualized key issues in supporting African American students' learning of mathematics. We used this framework as a tool to analyze studies identified in our search. Second, we report on the methods of our review. Third, we describe our findings, which are organized around two central questions:

> *Research Question 1:* What does research suggest regarding forms of teaching practice that support African American students' participation in rigorous mathematical activity?
> *Research Question 2:* What does research focused on African American students' experiences of learning mathematics suggest for the organization of teaching practice?

Finally, we reflect on our findings and suggest a research agenda focused on specifying forms of practice that support African American students' substantial participation in mathematics classrooms that are aimed at rigorous learning goals.

A Practice-Based Approach to Improving African American Students' Opportunities to Learn Mathematics

The Complexity of Specifying Supports for African American Students

There is inherent complexity in researching and specifying educational supports for particular populations of students (Clark, Johnson, & Chazan, 2009). One

runs the risk of essentializing (Gutiérrez, 2002a), in this case, youth who identify or are identified as African American.[3] As with any identifiable or self-identifying group of people, there is diversity in terms of African Americans' strengths, experiences, opportunities, preferences, and so forth. However, as Gloria Ladson-Billings (1997, 2000) argued, a set of historical conditions in the United States has characterized educational (and other) opportunities for African Americans. She wrote, "As a group, African Americans have been told systematically and consistently that they are inferior, that they are incapable of high academic achievement. Their performance in school has replicated this low expectation for success" (Ladson-Billings, 2000, p. 208). She argued that although it is crucial that African American students' experiences are not conceptualized as identical, it is important to understand and respond to their "social and cultural" experiences as unique (Ladson-Billings, 2000, p. 207). Therefore, Ladson-Billings suggested that supporting improved educational opportunities for African Americans likely involves the study and identification of how to reorganize instruction in ways that benefit African American students.

Danny Martin (2007, 2009a) made a similar argument. He suggested that if mathematics education research is to influence both policy and practice that will benefit African American students, such research should center on the experiences of African American students. Martin distinguished between mathematics education research that applies "research and policies generated for general student populations and that might residually apply to African American children" and "research and policies that are based on, and apply to, the mathematical experiences of African American children as *African American*" (Martin, 2009a, p. 5, emphasis in original; see also C. Lee, 2005). We use this distinction in our review of the literature; as we describe below, there is relatively little research that has approached the study of classroom instruction from the latter perspective. We agree with Martin, Ladson-Billings, and others that in the absence of such research, the question of how best to support African American students to participate in, and learn from, rigorous mathematical activity will remain unanswered.

Competing Lenses: Achievement in Mathematics Versus Opportunities to Learn Mathematics

Mathematics education researchers have documented the use and circulation of two ways of framing, or conceptualizing, African American students' learning of mathematics—through a lens of *achievement* and through a lens of *opportunities to learn*. The dominant way to frame African American

students' learning of mathematics is through a lens of achievement (cf. Gutiérrez, 2008; Martin, 2009a; Stinson, 2006); researchers examine African American students' performance as compared with other groups of students' performance on standardized mathematics assessments. Although achievement-based forms of comparisons have been made for decades (cf. Lubienski, 2002), the prevalence of such comparisons have arguably increased in response to the No Child Left Behind (NCLB) legislation. In exchange for federal dollars, NCLB requires states, which in turn require districts and schools, to report disaggregated student performance data in terms of racial (and other) groups. As a result, educational practitioners and researchers are operating in a context where there is perhaps more emphasis than ever before on comparing groups of students' performance on standardized assessments of mathematics.

This increased scrutiny has, on one hand, prompted explicit attention to improving the performance of African American students in mathematics, as illustrated in the interview with Ms. Mackey. On the other hand, the increased availability of achievement data has led to a prevalence of what some scholars have called "gap-gazing" (Gutiérrez, 2008). Given that African American students as a group tend to perform at lower levels when compared with their White and Asian peers, this frame often casts African American students as mathematically deficient (Martin, 2009a; Stinson, 2006). As Flores (2007) suggested, discussions of the achievement gap tend to focus on the symptoms of inequitable opportunities to learn mathematics without addressing the causes (see also Milner, 2008, 2010). Similarly, as Martin (2009a) argued, an achievement frame casts African American students as needing to be "fixed," as opposed to casting the instructional system as the problem in need of fixing.

An alternative way to frame African American students' learning of mathematics is in terms of *opportunities to learn*. Research has documented that African American (and other historically marginalized groups of) students are often schooled in underfunded schools and districts and are less likely to have access to highly qualified teachers and to higher-level mathematics courses, as compared with their middle-class White counterparts (Darling-Hammond, 2007; Flores, 2007; Ladson-Billings, 1997). Therefore, rather than focus on achievement outcomes or gaps, (mathematics) education scholars have suggested it is important to view trends that document African American students' underperformance in mathematics in terms of "opportunity gaps" (Flores, 2007).

In this article, we focus on the nature of African American students' opportunities to learn mathematics. Focusing on opportunities to learn entails

attending to the nature of the interactions between teachers, students, and mathematics in the contexts in which those interactions take place (Ball & Cohen, 1999; Ball & Forzani, 2007; M. L. Johnson, 1984; Martin, 2000). An opportunities to learn perspective asks what forms of learning, including opportunities to identify with mathematics (Nasir, 2002), are made possible, given the nature of interactions. An assumption in our review is that although other sites for mathematical development are important and affect students' academic learning and social identities specific to mathematics, the classroom is a primary site for such development and deserves particular attention. We have therefore restricted the focus of our review to classroom instruction.[4]

Specifying Learning Goals

Taking an opportunities to learn perspective necessarily involves making judgments about learning goals (i.e., what is worth knowing and doing mathematically). Decisions about what should happen instructionally should be driven by the nature of one's learning goals for students. When focusing specifically on *African American* students' opportunities to learn mathematics, two questions arise: (a) What should the mathematical learning goals for African American students be? and (b) Should learning goals for African American students be distinct from goals for other groups of students?

Questions of this type have no single answer. Answers will depend on one's conceptions of society, the relationship between education and society, and in particular, the role of *mathematics* education in society. At the same time, questions of this type, in our view, are crucial to consider, as various responses may result in distinct sets of learning goals, which may lead to exploring and enacting different forms of instructional practice aimed at supporting African American learners.

Considering the relationship between learning goals for classroom mathematics instruction and the purposes of education in society highlight the complexity of engaging in the improvement of learning opportunities for African American students. For example, a common rationale provided in reports on the state of mathematics education in the United States is that it is crucial to improve the mathematics achievement of all students to produce a better educated workforce, which is necessary to maintain the United States's economic position in the world (for an overview of the rationales provided in reports, see Martin, 2009a). Mathematics education scholars like William Tate (2005) and Danny Martin (2009a) have argued that workforce participation arguments commodify groups of children who, at present, are not succeeding, which tends to include children living in economically disadvantaged

areas, children of color, and children for whom English is not their first language. By this logic, a goal of mathematics education for African American children is to be able to participate in the U.S. economy—an economy that has, by and large, not served the majority of the African American community well.

In general, the mathematics education research community has reached consensus about learning goals for all students but has not reached consensus regarding goals for specific populations of students. Goals for all students are outlined in documents like the National Council of Teachers of Mathematics' (NCTM; 2000) *Principles and Standards for School Mathematics* and, more recently, the *Common Core State Standards* in mathematics (Common Core State Standards Initiative, 2010). At a minimum, mathematics education researchers generally agree that classroom instruction should aim to support students' conceptual understandings of key mathematical ideas and procedural fluency in a range of domains (e.g., number and operations, algebra, geometry, measurement, data analysis, and probability). Mathematics education researchers also generally agree that instruction should support students to engage in the disciplinary practices of mathematics (e.g., generalizing from a solution, justifying solutions, evaluating the reasonableness of solutions, making connections among multiple representations of a mathematical idea).

In addition to articulating discipline-specific learning goals, some mathematics educators have argued that an additional goal of learning mathematics for all students should be participation in democracy (e.g., Ball, Goffney, & Bass, 2005; Moses & Cobb, 2001). Exercising democratic rights requires the ability to critically consume quantitative arguments and mathematize everyday phenomena. Other mathematics education researchers have suggested that a goal of classroom instruction should be "learning mathematics for social justice," which entails, in Gutstein's (2003) terms, supporting students to develop "sociopolitical consciousness, a sense of agency, and positive social and cultural identities" (p. 40). This is accomplished as students are supported to use disciplinary knowledge and practices to inquire into and critique injustices and to suggest alternatives (see, for example, Greer, Mukhopadhyay, Powell, & Nelson-Barber, 2009; Gutstein, 2003; Gutstein, Lipman, Hernandez, & de los Reyes, 1997; Tate, 1995a).

Martin and McGee (2009) have written explicitly about their views on mathematical learning goals for African American youth. They maintained that against the "oppressive forces that African-American children will confront throughout the social contexts that define their lives," mathematics education must not only support African American students to develop understandings and practices called for in the NCTM *Standards* but also

allow "African-American learners to use mathematics . . . to change the conditions and power relations in their lives" (Skovsmose, 1994, p. 208). Furthermore, they argue, "[M]athematics education that is committed to anything less is irrelevant for African-American children" (p. 208).

Intentional consideration of additional goals and the broader purposes of mathematics education for African American students are essential. In our view, it is reasonable, and indeed desirable, to specify that all mathematics instruction should be aimed at learning goals compatible with those specified in the NCTM *Standards*, as these goals aim at developing enduring understandings of mathematics and of being able to communicate about those ideas. In addition, instruction should be aimed at supporting students to develop productive mathematical identities (Boaler & Greeno, 2000; Cobb, Gresalfi, & Hodge, 2009; Martin, 2000). The construct of mathematical identity is meant to account for, in Cobb et al.'s (2009) terms,

> the nature of mathematical activity as it is realized in the classroom, . . . what students come to think it means to know and do mathematics in the classroom, and . . . whether and why they come to identify with, merely comply with, or resist engaging in classroom mathematical activity. (p. 41)

In our view, it is especially important that learning goals for African American students include the development of productive mathematical identities (cf. Martin, 2000). Robust mathematical identities are likely to support African American students' future engagement and perseverance in mathematical activity (in and outside of classroom settings), especially in situations in which the conditions for their participation may be less than favorable. In the course of our review, we attended to the extent that learning goals were made explicit and, if they were made explicit, the nature of the discussion surrounding the articulation of learning goals.

Specifying Forms of Practice

We intentionally use the term *problem of practice* to describe our attention to supporting African American students' substantial participation in rigorous classroom instruction. On one hand, we intend to signal that supporting African American students in mathematics is a challenge that practitioners face, especially in U.S. urban classrooms. On the other hand, we intend to signal the need for mathematics education research that aims to specify "high-leverage" instructional practices (Ball & Cohen, 1999; Grossman et al.,

2009; Grossman & McDonald, 2008; Lampert, 2010). The central argument we make is that if the field of mathematics education is to contribute to the improvement of learning opportunities for African American students, it is necessary that researchers work to specify forms of instructional practice that are grounded in African American students' experiences and empirically shown to support their participation in rigorous mathematical activity and development of productive mathematical identities.

What is meant by the word *practice*? As Lampert (2010) argued, the word "practice" gets used in multiple ways in educational research. When we use the word "practice," we mean what teachers and African American students do in the classroom—how they interact with one another and with content, and how those interactions support (or do not support) learners to participate in and/or identify with mathematical activity. In Grossman et al.'s (2009) terms, "practice in complex domains involves the orchestration of skill, relationship, and identity to accomplish particular activities with others in specific environments" (p. 2059).

One important aspect of specifying forms of practice involves identifying orientations that teachers can develop that are productive for African American students' mathematics learning. Mainstream educational research attempts to document the characteristics, or qualities, of mathematics teachers that are associated with positive learning and/or achievement outcomes on the part of students. Typical characteristics that are investigated include quantifiable measures like "certification, subject matter background, pedagogical training, selectivity of college attended, test scores, [and] experience" (Darling-Hammond, 2007, p. 323). Measures like these are framed as indicators of "teacher quality." Research has documented that, according to these measures of teacher quality, African American youth, particularly those who live in economically disadvantaged areas, are often taught by less qualified teachers than their White peers from middle-class backgrounds (Darling-Hammond, 2007; Tate, 2008).

In Martin's (Martin, 2007; see also Tate, 2008) terms, findings about inequitable access to highly qualified teachers raise an important question—"Who should teach mathematics to African American children?"(Martin, 2007, p. 6)—especially because there is evidence that teachers often blame African American students, their families, and their communities for trends of underperformance in mathematics (Bol & Berry, 2005; Linn, Bacon, Totten, Bridges, & Jennings, 2010). Is it a matter of finding ways to increase, for example, the number of teachers with mathematics degrees who attended highly selective colleges to teach in settings that serve African American youth? And/or, does it require identifying orientations of teachers who are effective in providing African American students with significant

opportunities to learn mathematics? Martin (2007) cautioned that research that focuses solely on mainstream criteria (e.g., mathematics content knowledge, degree, certification status) is inadequate to answer the question of who should teach mathematics to African American youth. He suggested the need for research that, in addition to accounting for the typical measures of teacher quality, investigates "teachers' dispositions and beliefs about who can and cannot learn mathematics, who is math literate and who is not, and why they believe what they do" (Bol & Berry, 2005, cited in Martin, 2007, p. 14). Similarly, Grossman and McDonald (2008) suggested,

> Any framework of teaching practice should encompass these relational aspects of practice and identify the components of building and maintaining productive relationships with students. Such an understanding might be particularly useful in preparing teachers who can work effectively with students who differ from them in terms of race, ethnicity, socioeconomic status, and language. (p. 188)

A second, related aspect of specifying forms of practice involves identifying forms of practice—what teachers and students do together in the classroom—that are productive for African American students' mathematics learning. To date, the mathematics education research community has identified a set of instructional practices that have been empirically shown to support students' development of conceptual understandings of key mathematical ideas and procedural fluency (Franke, Kazemi, & Battey, 2007). For example, teachers should pose cognitively demanding tasks that require students to explain their reasoning (Stein, Smith, Henningsen, & Silver, 2000). It is also generally accepted that instruction should consist of opportunities for students to engage in whole-class discussions of their solutions to complex mathematical problems (Stein, Engle, Smith, & Hughes, 2008). However, on our reading, most research focused on the identification of productive forms of practice has assumed a generic student; it has not intentionally focused on African American students (see also Martin, 2009a).

Why might this be problematic? Consider, for example, the various skills, knowledge, and relationships that must be established to effectively orchestrate a concluding whole-class discussion of a complex task. It involves listening carefully to student thinking, identifying particular student solutions to make public, purposefully sequencing those solutions to support students to make mathematical connections, negotiating norms of how to participate in whole-class discussions, supporting students to make connections

among solutions, publicly representing student work and ideas, and so forth (Stein et al., 2008). The relational work entailed in orchestrating productive whole-class discussions (i.e., those that improve the learning of all students in the classroom) is impressive. It may be that by systematically investigating how African American children can be supported to engage in mathematical argumentation, researchers can discern how to establish productive relationships and norms that allow for rich mathematical conversation that, in turn, support the development of African American students' mathematical understandings and productive mathematical identities (Davis & Martin, 2008; Martin, 2007). To be clear, we are not arguing that forms of practice generally thought to be worthwhile for all students might not also be worthwhile for African American students. Rather, we are suggesting the importance of focusing squarely on how forms of practice get established in different settings serving African American students and to what ends (both academically and socially).

There is a tension in specifying practice (Gutiérrez, 2009; Kazemi, Franke, & Lampert, 2009; Lampert & Graziani, 2009). High-quality mathematics teaching is necessarily a contingent activity—a teacher's decision regarding who to question, what mathematical ideas to press on, and so forth depend, for example, on what he or she knows about students' understandings and experiences (Ball & Forzani, 2009; Lampert & Graziani, 2009). A call for the specification of practice is often interpreted as trying to tightly "script" teaching—that is not what we are suggesting. Instead, specifying practice unpacks and makes visible the work that, in this case, teachers who support African American students to learn mathematics with understanding and develop productive mathematical identities do. A crucial element of specifying forms of practice involves what Grossman et al. (2009) called "decomposing" the practices of teaching into its constituent parts. In Grossman et al.'s (2009) terms, "Decomposition makes visible the grammar of practice and may require a specific technical language for describing the implicit grammar and for naming the parts" (p. 2069).

In arguing for specifying forms of practice, we follow Ball and Forzani (2009) in making two assumptions: teaching (mathematics) is unnatural, and it is complex work. It is not likely that teachers will spontaneously develop forms of practice that support African American students to learn mathematics with understanding. Thus, we see great value in specifying forms of practice (Ball, Sleep, Boerst, & Bass, 2009) for which there is empirical evidence that, when developed, support African American students to substantially participate in, and learn from, instruction aimed at

rigorous learning goals. They are, in our view, the key to responding to the problem of practice that Ms. Mackey articulated—"*How* do I support African American learners in mathematics?"

Method

Our goal in conducting this literature review was to synthesize the mathematics education research literature specific to supporting K-12 African American students' participation in mathematics aimed at rigorous learning goals since the advent of the 1989 NCTM *Standards*. We generally focused on studies particular to the teaching and learning of *mathematics*. We did not include literature, for example, on successful teaching of African American students more generally or in other content areas. This is a potential limitation of this review. However, we felt that it was important to assess the state of *mathematics* education research specific to supporting African American learners.

We first conducted database searches in ERIC and PsychInfo. Our search words were purposefully broad in an effort to be as inclusive as possible; in ERIC, our query included keywords African Americans and math*, whereas in PsychInfo, our query included keywords African Americans or Blacks and math*.[5] We limited the results to those published since 1989. In addition, we generally limited the results to peer-reviewed research. The databases capture articles from most peer-reviewed journals, books, book chapters, reports, and dissertations. Although books and book chapters do not follow a similar peer-review process as do journal articles, we included them in our initial listing, given that there is generally some editorial review of books and book chapters. We did not include any dissertations in our initial listing, as we wanted to restrict our focus to peer-reviewed research.[6] We generally did not include reports for the same reason, however, based on the abstract, a small number appeared to be highly relevant, so we subjected those to an initial screening.

Our database searches provided a listing of 855 relevant documents. We then reviewed each abstract in an effort to initially screen the list of studies. One criterion was that the study had to focus on K-12 African American students and mathematics instruction. In addition, we preferred a U.S. focus (given the U.S.-specific history of educational opportunity for African Americans). However, we reviewed studies involving non-U.S. populations if they appeared relevant in other ways (e.g., a focus on Black populations' learning of mathematics in contexts that were arguably similar to the United States).

Only 102 of the original 855 documents (68 journal articles, 6 books, 22 book chapters, 6 reports) met our initial screening criteria. It is worth noting that we initially rejected the majority of documents (nearly 89%) because they did not focus in any way on opportunities to learn mathematics in K-12 school settings. Most were psychological studies focused on African American populations that used measures of mathematics learning (e.g., mathematics achievement scores) to make claims about home support, environment, and/or assumed psychological traits of African Americans.

Although major journals in educational research and the field of mathematics education were included in both databases, we also conducted a hand-search of a number of journals (1989-present) to be sure we had not missed any relevant articles. We hand-searched the prominent mathematics education journals, namely, *Journal for Research in Mathematics Education*, *Mathematical Thinking and Learning*, and *Educational Studies in Mathematics*. We also hand-searched the following prominent educational research journals (not specific to mathematics education): *American Educational Research Journal*, *Cognition and Instruction*, *Educational Researcher*, *Journal of the Learning Sciences*, *Teachers College Record*, *Urban Education*, and *Urban Review*. In addition, as we read articles and books, we identified any relevant research that was cited (and not discovered in our previous searches) and reviewed that as well. Our hand-search of journals provided an additional 10 journal articles to review, and we located an additional 2 books and 2 book chapters when reading relevant studies.

Next, we divided up the documents and read each one thoroughly. We created an annotated bibliography, with an entry for each document. Throughout the creation of the annotated bibliography, we met on a regular basis and discussed our annotations. In the end, 100 documents proved relevant (74 journal articles, 20 book chapters, 4 books, and 2 reports). In response to the content of the relevant documents, we identified five broad categories into which we grouped the documents:

1. framing, or conceptualizing, African American students' performance and learning of mathematics;
2. teachers' orientations to the teaching of mathematics to African American students;
3. instructional practices in mathematics classrooms serving African American students;
4. African American students' experiences of learning mathematics; and
5. institutional supports and structures (e.g., professional development for teachers, detracking) associated with African American students' mathematics learning.

Table 1 provides a summary of each document that we included in our review, organized within the five categories.[7]

Our theoretical framework was informed by the framing studies (Category 1). The findings we present are organized around (a) orientations to teaching mathematics and instructional practices that have been documented to support African American students' participation in rigorous mathematical activity (Categories 2 and 3) and (b) African American students' experiences of learning mathematics (Category 4). Category 5 documents are not the focus of our review; however, we briefly discuss institutional supports and structures in the final section of this article. Given space limitations, we do not discuss every relevant article. Instead, we have chosen to report on findings that cut across studies and findings from particular studies that illustrated a unique perspective.

Orientations to Teaching Mathematics and Instructional Practices That Support African American Students' Participation in Rigorous Mathematical Activity

Findings

There are a handful of studies that have identified orientations to teaching mathematics that have been shown to support African American students' learning of mathematics. A few studies have attempted to identify orientations to teaching mathematics to African American students aimed at the goals outlined in the NCTM *Standards*. For example, Malloy (2009) studied teachers' orientations, practices, and student learning in 126 middle-grades classrooms across 44 teachers. Data included classroom observations (coded using the *Reformed Teaching Observation Protocol*), interviews with teachers, a student survey designed to investigate students' perception of instruction, and an assessment (administered in the fall and spring) designed to measure students' conceptual understanding of mathematics. She identified four teachers from the sample whose African American students achieved the greatest growth in conceptual understanding; their classroom instruction was also rated among the highest levels of reform-oriented instruction, as based on the *RTOP*. Malloy found that the four teachers differed in their teaching approaches. However, she identified that they shared similar orientations to teaching African American students. In particular, Malloy found they

Table 1. Literature Reviewed Specific to Supporting K-12 African American Students' Opportunities to Learn Mathematics (1989-May 2011)

Five categories of literature	Journal article	Book chapter	Book	Report
Framing African American students' performance and learning of mathematics				
Ball, Goffney, and Bass (2005)	✓			
Darling-Hammond (2007)	✓			
Diversity in Mathematics Education Center for Teaching and Learning (2007)		✓		
Flores (2007)	✓			
Gutiérrez (2002b)	✓			
Gutiérrez (2009)	✓			
Gutstein et al. (2005)	✓			
Jones (1993)		✓		
Ladson-Billings (1997)	✓			
J. Lee (2002)	✓			
Martin (2009a)		✓		
Martin (2009b)	✓			
Martin and McGee (2009)		✓		
Moody (1998)	✓			
Moses (1994)	✓			
Moses and Cobb (2001)			✓	
Moses-Snipes and Snipes (2005)	✓			
Nasir (2002)	✓			
Nasir et al. (2009)		✓		
Nasir and Hand (2008)	✓			

(continued)

Table 1. (continued)

Five categories of literature	Journal article	Book chapter	Book	Report
Russel (2005)	✓			
Secada (1996)	✓			
Spencer (2009)		✓		
Tate (1994)	✓			
Tate (2005)	✓			
Williams and Lemons-Smith (2009)	✓			
Wilson and Banks (1994)	✓			
	Total 20	6	1	0
Teachers' orientations to the teaching of mathematics to African American students				
Bol and Berry (2005)	✓			
Brown (2000)		✓		
Clark, Johnson, and Chazan (2009)		✓		
Jamar and Pitts (2005)	✓			
Linn, Bacon, Totten, Bridges, and Jennings (2010)	✓			
Malloy (2009)		✓		
Martin (2007)	✓			
Tate (2008)	✓			
	Total 5	3	0	0
Instructional practices in mathematics classrooms serving African American students				
Bailey and Boykin (2001)	✓			
Berry (2003)	✓			
Berry and McClain (2009)		✓		
Bodovski and Farkas (2007)	✓			
Checkley (2001)	✓			

(continued)

Table 1. (continued)

Five categories of literature	Journal article	Book chapter	Book	Report
Clarkson, Fawcett, Shannon-Smith, and Goldman (2007)	✓			
Corey and Bower (2005)	✓			
Davis and Martin (2008)	✓			
Eglash, Bennett, O'Donnell, Jennings, and Cintorino (2006)	✓			
Enyedy and Mukhopadhyay (2007)	✓			
Greer, Mukhopadhyay, Powell, and Nelson-Barber (2009)			✓	
Hurley, Boykin, and Allen (2005)	✓			
Lattimore (2005a)	✓			
Lattimore (2005b)	✓			
C. Lee (2005)		✓		
Leonard (2008)			✓	
Lubienski (2002)	✓			
Lubienski (2006)	✓			
Manswell Butty (2001)	✓			
Matthews (2008)	✓			
Matthews (2009)		✓		
McGlamery (2000)	✓			
Moses, West, and Davis (2009)		✓		
Moses-Snipes (2005)	✓			
Mueler and Maher (2009)	✓			
Murrell (1994)	✓			
Rowser and Koontz (1995)	✓			

(continued)

Table 1. (continued)

Five categories of literature	Journal article	Book chapter	Book	Report
Silver, Smith, and Nelson (1995)		✓		
Silver and Stein (1996)	✓			
Taylor (2009)	✓			
Thompson (2007)	✓			
Tobias (1992)	✓			
Walker (2009)		✓		
Wenglinsky (2004)	✓			
	Total 26	6	2	0
African American students' experiences of learning mathematics				
Berry (2008)	✓			
Brand, Glasson, and Green (2006)	✓			
Ellington and Frederick (2010)	✓			
Jackson (2009)		✓		
Y. Johnson (2009)		✓		
Lim (2008)	✓			
Malloy and Jones (1998)	✓			
Martin (2000)			✓	
Moody (2001)	✓			
Moody (2004)	✓			
Sheppard (2006)	✓			
Stinson (2006)	✓			
Stinson (2008)	✓			

(continued)

Table 1. (continued)

Five categories of literature	Journal article	Book chapter	Book	Report
Stinson (2009)		✓		
Stinson (2010)	✓			
Struchens and Westbrook (2009)		✓		
Thompson and Lewis (2005)	✓			
Walker (2006)	✓			
	Total 13	4	1	0
Institutional supports and structures associated with African American students' mathematics learning				
Archer (1993)				✓
Ballon (2008)	✓			
Gamoran and Hannigan (2000)	✓			
Gutiérrez (2000)	✓			
Horn (2004)	✓			
M. Johnson and Brown (2009)		✓		
Oakes, Ormseth, Bell, and Camp (1990)				✓
Riegle-Crumb (2006)	✓			
Stone (1998)	✓			
Tate (1995b)	✓			
Walker (2007a)	✓			
Walker (2007b)	✓			
Yates and Collins (2006)	✓			
	Total 10	1	0	2
Totals across all categories	74	20	4	2

> believed that all students could learn mathematics; valued student motivation, involvement, effort, respectful behavior, and responsibility; demonstrated concern to address the varied learning styles of their students and accommodated instruction-based student learning preferences; demonstrated that knowledge their students brought into the classroom should be shared; helped their students feel safe in their classrooms and cared about their students and their learning; and were reflective about their practice. (pp. 104-106)

Jamar and Pitts (2005) investigated one middle-grades teacher's orientations to teaching who articulated a reform-oriented vision of mathematics instruction and taught predominantly African American students. In particular, Jamar and Pitts identified three "messages" that the teacher regularly communicated to students. He communicated that the students had the "foundation" needed to learn new mathematics by eliciting and building on the students' prior knowledge. Second, "by expecting students to be active participants in their own learning, he made it clear that they were to take responsibility for their own learning" (p. 130). In addition, "by providing opportunities for students to *understand* concepts prior to learning rules, he made it clear that they *could* understand the content and that it was understandable" (p. 130, emphasis in original).

Studies like Malloy's (2009) and Jamar and Pitts (2005) are useful in establishing orientations of teachers for whom there is empirical evidence that they support African American students' participation in rigorous mathematical activity. However, descriptions of teachers' relational work in the classroom tend to remain at the level of relatively abstract characterizations or principles. Our findings generally fit with Grossman and McDonald's (2008) characterization of the literature on relational practices. They wrote, "[T]here is relatively little attention in the empirical research literature on how teachers establish pedagogical relationships with students and how they use those relationships to engage students in learning" (p. 188). An important next step, in our view, is for researchers to move beyond general descriptions and detail, at the interactional level, *how* successful teachers negotiate productive relationships and establish norms with African American students. It would also be important to investigate how teachers learn to develop such orientations and establish relationships in classrooms.

Research on culturally relevant teaching (CRT) is promising in terms of specifying orientations to teaching and forms of practice specific to African American students and mathematics teaching. Gloria Ladson-Billings (1992) proposed a framework of CRT, centered in supporting African American

students' academic and social development based on her study of successful elementary school teachers of African American students. Ladson-Billings specified three goals for what students should be able to do as a result of culturally relevant classroom instruction: Students should be academically successful (as measured by typical achievement tests), "demonstrate cultural competence" (or maintain their "cultural integrity"), and "both understand and critique the existing social order" (Ladson-Billings, 1995, p. 474).

Against these goals for students' academic and social development, Ladson-Billings (1995) identified two important orientations: teachers' conceptions of self and others, and teachers' conceptions of knowledge (pp. 478-481). Teachers who supported African American students believed that all of their students were capable of academic success, and they saw themselves as members of the community in which they taught. In addition, they conceptualized knowledge as dynamic and therefore were able to support students to view knowledge critically. Ladson-Billings also found that culturally relevant teachers deliberately structured classroom relationships to support students to be academically successful, develop cultural competence, and develop critical consciousness.

Gutstein et al. (1997) built on the work of Ladson-Billings and proposed a model of culturally relevant teaching specific to mathematics that includes three components. The first component focuses on supporting students to become critical thinkers and to view knowledge critically, which includes "making conjectures, developing arguments, investigating ideas, justifying answers, [and] validating one's own thinking" (Gutstein et al., 1997, p. 718). The second component specifies making "connections between building on students' informal mathematical knowledge and building on students' cultural and experiential knowledge" (Gutstein et al., 1997, p. 718). To make meaningful connections between students' informal, experiential knowledge and classroom instruction, Gutstein et al. (1997) and others (Gutiérrez, 2002a; Moschkovich, 2007) argued that teachers need to develop particular "orientations to their students' culture and experiences" (Gutstein et al., 1997, p. 718). Thus the third component of Gutstein et al.'s model specifies the type of orientation teachers should develop with respect to their students' out-of-school knowledge and experiences.

Gutstein et al. (1997) suggested that culturally relevant teachers need to develop an "empowerment orientation" as opposed to a "deficit orientation." A deficit orientation can include "failing to challenge students academically," the framing of students' cultures and out-of-school knowledge as a hindrance or an obstacle to be overcome, or the romanticization of students' cultures (p. 727). It can also include teachers seeing themselves as "saviors"

who will save the students from their "culture" or parents (cf. Martin, 2007). Gutstein et al. warned that teachers can be familiar with students' cultures and out-of-school experiences and still hold a deficit orientation. However, an empowerment orientation "helps create the conditions for students to develop personal and social agency" (Gutstein et al., 1997, p. 727). Characteristics of teachers who hold an empowerment orientation include "establishing solidarity with students and their families," understanding cultural norms as shifting (i.e., not as static ways of being), and "providing academic challenges" (p. 727).

Ladson-Billings' work on elaborating CRT was specific to African American students. However, even though the elementary teaching she studied included teaching mathematics, her focus was not specific to *mathematics* teaching. Although Gutstein et al.'s work on elaborating CRT was specific to mathematics teaching, it was not grounded in explicit investigations of supporting African American students. There have been significant attempts to support teachers to develop culturally relevant practices in mathematics and to support students of color to learn mathematics in classrooms using culturally relevant pedagogy and curriculum (e.g., Averill et al., 2009; Brenner, 1998; Civil & Andrade, 2002; Enyedy & Mukhopadhyay, 2007; Gutstein et al., 1997; Lipka et al., 2005; Matthews, 2008). Together, these studies have highlighted the importance of having explicit discussions regarding how the problem scenarios of mathematical tasks relate to students' out-of-school lives (Gutstein et al., 1997; Leonard, 2008; Moses, West, & Davis, 2009), supporting students' use of "home" languages in instruction (Gutiérrez, 2002a; Moschkovich, 2005), and supporting students to connect their "everyday" language with mathematical language (Moschkovich & Nelson-Barber, 2009). However, there are very few studies of culturally relevant mathematics teaching in contexts with predominantly African American students that focus on the nature of interactions that support (or do not support) African American youth to achieve particular goals (e.g., Enyedy & Mukhopadhyay, 2007; Leonard, 2008).

An example of a study of culturally relevant mathematics teaching with predominantly African American students that explicitly focused on the relationship between practice and learning goals is that of Enyedy and Mukhopadhyay (2007). Whereas some studies of CRT have documented that both academic (e.g., achievement on standardized tests) and social (e.g., development of cultural competence and critical consciousness) goals were met for students (Gutstein, 2003; Gutstein et al., 1997; Moses et al., 2009), Enyedy and Mukhopadhyay described what they call "tensions" between attending to both mathematical and social goals for students in the context of

a culturally relevant mathematics project. They designed and researched a community mapping project in which predominantly African American and Latino high school students from economically disadvantaged areas of a city were supported to "study and produce maps of demographic trends and educational outcomes for their own communities using . . . a Geographic Information System (GIS)" (p. 140). Mathematically, the researchers intended that the students would learn key statistical concepts and forms of mathematical argument. Socially, the researchers intended that the community mapping project would "help students to develop critical perspectives through open-ended projects related to their everyday lives" (p. 140). Enyedy and Mukhopadhyay provided evidence that the students gained experience with tools to engage in public discussion of social issues that made use of quantitative arguments, developed their understandings of "statistical inference" (p. 167), and developed an appreciation for the relevance of mathematics to their lives. However, they also provided evidence that because the content was very familiar to them (e.g., maps of their own communities), students often focused on using the quantitative information to support claims that were grounded in their lived experiences as opposed to using the quantitative information to question the veracity of their claims. Enyedy and Mukhopadhyay described this as a tension between the "academic goals and norms of statistics" and the goal of the project to support students to take a position on the social conditions of their world (p. 168). This study is useful, in our view, in that it highlights the complexity of enacting and accomplishing the learning goals associated with culturally relevant mathematics teaching.

Keeping in mind that African American students vary in terms of experiences, orientations, and so forth, it seems important that the focus of future CRT research in mathematics explicitly take into account the specificity of supporting *African American* learners. For example, how do mathematics teachers who support African American students in different settings develop "empowerment" orientations? What is the work entailed in coming to view knowledge critically, in the context of teaching and learning mathematics with African American students? As illustrated by Enyedy and Mukhopadhyay's (2007) study, it also seems crucial to maintain careful attention to the complex relationships between forms of practice and learning goals (both academic and social).

A distinction we make throughout this review is between studies that are based on general student populations (which might include African American students) and might apply to supporting African American children's learning of mathematics and studies that are explicitly grounded in the mathematical teaching, learning, and experiences of African American students (Martin,

2009a). One program noted for its attention to African American students' cultural backgrounds and the development of rich understandings of mathematical ideas is Bob Moses and colleagues' (Checkley, 2001; Moses & Cobb, 2001; Moses et al., 2009) Algebra Project. Although the Algebra Project was originally designed to support low-performing African American middle- and high-school students to develop rich understandings of algebraic ideas, it now serves racially diverse groups of low-performing students. Reports indicate the success of African American youth who are involved in the Algebra Project in terms of algebra pass rates, performance on standardized assessments, and college attendance (Moses et al., 2009). However, there is little empirical research on the nature of instruction in Algebra Project classrooms. Project materials report that it includes both structural changes to the mathematics classroom (e.g., students are in a cohort for 4 years of high school, students have math for 90 min every day, small class size) and changes in the organization of instruction (Moses et al., 2009). For example, each module begins "with experiences that are eventually 'mathematized'" (p. 246) thus providing all students with a common experience to ground their mathematical thinking. Instruction also emphasizes mathematical communication and representation; students are supported to make connections between their everyday language and mathematical language (Moses et al., 2009). These descriptions of how classroom instruction is organized are useful, in our view, in that they are concrete and potentially learnable by teachers. However, empirical research would be needed to "decompose," for example, how it is that teachers provide African American students with a common experience to ground their mathematical thinking.

One set of studies specific to African American children builds on the work of Boykin (1986) regarding African American students' *learning preferences* and aspects of mathematics instruction (Bailey & Boykin, 2001; Hurley, Boykin, & Allen, 2005; Malloy & Jones, 1998; Rowser & Koontz, 1995). Studies of learning preferences tend to be experimental in nature and isolate narrow aspects of mathematics instruction; they do not attend to the nature of interactions between teachers, students, and the content. If we were to try to specify ways of organizing the classroom that emphasizes a particular learning style (e.g., communalism), we would need to know the answers to questions like "How does a teacher negotiate norms of "communalism" with his or her students?" and "What types of tasks lend themselves to working communally?" Thus, in our assessment, studies of African American students' learning preferences specific to mathematics in and of themselves are not sufficient in terms of specifying forms of practice.

A central finding from our review is that in general, there is limited research that investigates instructional practices in contexts predominated by African American students in relation to students' learning and/or achievement on standardized assessments. Lubienski (2002), for example, lists studies that examine schools, teachers, curriculum, as well as student motivation, but she argues that they focus on "overall academic performance and experiences of Black students, as opposed to an in-depth examination of achievement and instructional practices" (p. 270). Of the studies that do attempt to connect the nature of instruction with outcomes, they often focus on interventions, or programs, emphasizing "what works" without specifying why, how, and under what conditions a particular intervention or program works (e.g., Brown, 2000; Clarkson, Fawcett, Shannon-Smith, & Goldman, 2007). In our view, this is a significant weakness of the research literature. In the absence of connecting learning opportunities to learning outcomes, educational researchers and practitioners, as well as the general public, are left with little material with which to make sense of trends of mathematics achievement for African American students.

There are a limited number of studies that attempt to get at the "how" of relationships between the nature of instruction and learning outcomes for African American students; however, they generally are not able to inform the decomposition of practice. For example, Lubienski (2006) examined the relationship between instructional practices and achievement disparities and found that teachers' "non-number curricular emphasis, use of collaborative problem solving strategies, and knowledge of NCTM standards were significant predictors of fourth grade mathematics achievement" after controlling for socioeconomic status, race, disability status, gender, and school sector (p. 20). However, she used survey data for determining the nature of practice, which she herself acknowledged as limited. Although survey-based studies may point to important characteristics of practice, they alone are not suited to support the development of a "grammar" (Grossman et al., 2009) of practice that support African American students.

An example of research that carefully examines the relationship between classroom practice and third-grade African American students' performance on standardized assessments is that of Walker (2007). Walker and colleagues provided professional development specific to using cognitively demanding tasks and formative assessment in instruction (e.g., eliciting and responding to student thinking throughout the lesson). Walker found that students' performance on assessments was generally positively related to the quality of teachers' questions and responses to student thinking. However, she also found

that some students who continued to perform at low levels on standardized assessments demonstrated improvement in conceptual understanding of mathematical ideas on classroom tasks. Her careful study of instruction led her to raise questions about whether African American students' performance on standardized assessments accurately reflects what they understand mathematically.

Another example of research that, in our view, carefully examines the relationship between classroom practice and learning outcomes for students is the Quantitative Understanding: Amplifying Student Achievement and Reasoning (QUASAR) project (Silver, Smith, & Nelson, 1995; Silver & Stein, 1996). QUASAR was a deliberate attempt to alter the nature of instruction in urban, middle schools. It was premised on the idea that the

> oft-reported low levels of participation and performance in mathematics for poor urban students in the middle grades are not due primarily to a lack of student ability or potential but rather to a set of educational practices that fail to provide them with high-quality mathematics learning opportunities. (Silver & Stein, 1996, pp. 476-477)

Teachers were provided with intensive professional development aimed at supporting them to fundamentally reorganize their instructional practices; they were supported to use cognitively demanding tasks (e.g., tasks with multiple entry points, multiple solution paths), foster connections between students' experiences and mathematical ideas, foster communication among students, and establish particular social norms (e.g., "criticize ideas not people"; Silver et al., 1995). Research documented gains in student learning (especially on tasks aimed at conceptual understanding) for all students when teachers used tasks of high-cognitive demand and maintained the demand throughout lessons (Silver & Stein, 1996). Although the majority of the students in QUASAR classrooms were African American, the research was not squarely focused on issues specific to the teaching of African American students (cf. C. Lee, 2005). That said, it suggests forms of practice (e.g., maintaining cognitive demand during various phases of a lesson, orchestrating a concluding whole-class discussion focused on student ideas) that could be explored further with a deliberate focus on African American students.

To this point, Murrell (1994) was a member of the QUASAR research team and conducted research specifically on the experiences of 12 African American male students across four of the QUASAR classrooms (in four schools) who were identified by teachers as "low ability." Murrell was concerned with the extent to which the discourse practices being emphasized might marginalize

African American male students since it was a form of discourse they were unfamiliar with. Murrell reported that the focal students generally did not develop the desired forms of discourse. It was somewhat difficult to evaluate Murrell's findings; he did not present evidence from his data to support his conclusions. However, the intention of his inquiry is useful, in our view, as it raises questions around the challenges entailed in supporting the development of forms of practice with which students might be unfamiliar. Based on his findings, Murrell recommended that teachers "make explicit the rules of talk and performance expectancies for all occasions of classroom discourse, including cooperative group discussions and informal off-task as well as whole-class inquiry" (p. 565). This fits more generally with research on supporting African American students that suggests the importance of making the "code" of classroom participation explicit (Delpit, 1995).

Summary

The aim of the above section was to describe findings that suggest orientations to teaching and forms of practice that have been shown to support African American students' participation in rigorous mathematical activity. Based on our review, there are very few studies of mathematics teaching and learning that have squarely focused on African American students. Of the studies that do, few penetrate to the core interactional work of teaching and learning. Instead, knowledge of how to support African American learners in mathematics tends to reside at the level of general principles. In particular, research on the "how" of developing and enacting productive relationships and supporting African American students to participate in rigorous mathematical activity remains thin. There is certainly an emerging set of findings on which to follow up. For example, across all the studies reviewed, it appears that providing African American students' with a common experience in which to ground the development of central mathematical ideas and explicitly supporting African American students to participate in increasingly sophisticated forms of mathematical communication and argumentation emerges as important. The next steps would be to engage in research aimed at decomposing the development of those orientations and practices in contexts that support African American learners and to detail the consequences of those orientations and practices for African American learners, academically and socially. In addition, it seems important to engage in research aimed at identifying additional productive orientations and forms of practice in classrooms serving African American students.

African American Students' Experiences of Learning Mathematics

Findings

Thus far, we have focused exclusively on the orientations and work of teachers. In this section, we direct our focus to the experiences of African American students in mathematics and ask what the relevant literature suggests for the organization of teaching practice. In the last decade or so, a new body of scholarship has emerged regarding the experiences of African American students as learners of mathematics, particularly those who identify as *successful* learners of mathematics. Based on our reading of the literature, we attribute this new body of work to Martin's (2000) publication, *Success and Failure Among African-American Youth: The Roles of Sociohistorical Context, Community Forces, School Influence, and Individual Agency*. Martin deliberately studied African American students' success, as well as failure, in mathematics in a predominantly African American junior high school in Oakland, California. His attention to success was aimed at moving the field of mathematics education research beyond dominant narratives that construct African Americans as mathematically illiterate (Martin, 2009a). Since the publication of Martin's book in 2000, we identified 13 studies that have inquired into the experiences of successful African American learners in mathematics.

A major contribution of Martin's (2000) work was the identification of "forces" that shaped middle-grades African American students' opportunities to succeed (and fail) in mathematics; he presented these in a multilevel framework. Martin argued that students contend with interpersonal forces (e.g., their personal identities and goals as well as their beliefs about mathematics ability, the importance of mathematics knowledge, and differential treatment from peers), school-based forces (e.g., school-based support systems, teacher beliefs about student abilities and motivation to learn, teacher beliefs about African American parents and communities, and student culture and achievement norms), as well as community-based forces (e.g., educational goals, expectations for children and educational strategies, and relationships with school officials and teachers). Martin empirically demonstrated how these forces contributed to the ways in which African American youth were socialized to use and view mathematics as well as to the development of their mathematics identities.

Martin's work emphasized that success (and failure) is produced as individuals interact with others in context. Martin (2007) wrote,

> It is necessary . . . to consider how teachers act on their perceptions of African American learners and how those actions help shape the cultural, racial, and mathematics identities of African American students. The negotiations that take place between students and teachers are likely to reveal important findings leading to better understandings not just of achievement outcomes but the relationships between achievement outcomes and student identities. If students do not experience mathematics in their classrooms in ways that support the development of positive mathematical and racial identities, for example, disengagement and low achievement might represent one set of reasonable responses. (p. 22)

Jackson's (2009) study of two African American fifth graders learning mathematics illustrated the complex, interactional work entailed in accomplishing "success." She documented the circulation of discourses specific to low-income children of color among the school staff and the instructional consequences in terms of students' opportunities to learn mathematics. One of the focal youth was publicly identified as successful, however, as Jackson documented, this "success" involved negotiating difficult gender dynamics in the classroom. Moreover, the mathematical work the youth was rewarded for was rather limited in scope and would not likely serve her in future academic situations. Jackson suggested not only the importance of attending to how students achieve success in mathematics but also the importance of understanding what constitutes "success" in particular classrooms and schools.

Several studies focused on African American students' experiences of learning mathematics elaborate the school and community levels of Martin's (2000) framework (Berry, 2008; Stinson, 2010; Walker, 2006). For example, Berry (2008) investigated the success of eight African American male middle-school students and attributed the success of these students to factors outside of school and to effective connections with caring adults (both in and out of the school context). Berry also identified community and school forces that prevented African American males from being academically successful, namely, those that limited access to advanced mathematics classes. These factors included teachers' failure to recognize abilities, "educational gatekeepers" (e.g., teachers and other school personnel) who evaluated academic potential and limited access to opportunities, and perceived racism toward poor students and students of color. In a study of four mathematically successful African American males, Stinson (2010) found that family and community

members were critical in advocating for and assisting them in accomplishing success in mathematics. The successful students attributed their success to families, trusting relationships developed with teachers who had high expectations, and participation in high-level mathematics courses with high-achieving peer groups.

Other studies have focused on the intersection of interpersonal and school forces (Lim, 2008; Moody, 2001; Sheppard, 2006; Walker, 2007a). In a study of successful African American students in schools labeled as *unacceptable* under NCLB-related legislation, Sheppard (2006) attributed the students' mathematics success to mathematics teachers and to the personal traits of the students as individuals, given the lack of supports at the school level. Walker (2007) also pointed to the intersection of the school and interpersonal contexts by focusing on teacher attitudes and school resources. She attributed African American students' lack of success to a lack of opportunities at school (e.g., rigor of curricula, variety of course options, and the number of enrichment opportunities).

Other scholars have strictly focused on the interpersonal context (Brand, Glasson, & Green, 2006; L. R. Thompson & Lewis, 2005). Thompson and Lewis (2005) documented one African American male high school student's success in mathematics and found that factors like having role models and explicit life goals played a part in motivating him to succeed in mathematics. Thompson and Lewis attributed the student's success to his own forward thinking and drive to reach his goal of attending a competitive college in order to become a pilot.

Summary

We view this set of studies that focuses on African American students' experiences (particularly of successful students) as providing an important contribution to the field. It provides a counternarrative to the dominant deficit-oriented narrative regarding African American students and mathematics. However, we also raise a couple of questions regarding studies that attend to the perspectives of successful African American learners. First, it is often not clear how success is being defined. In other words, the majority of the aforementioned researchers articulated what they attribute the success of the focal African American learners to, but they were often not explicit in stating what constituted success in a given environment or how they determined who was successful. Was success determined based on achievement on state assessments and/or grades? Were these students participating in rigorous mathematical activity, or were they successful in mathematical activity that emphasized

completing procedures void of mathematical meaning (Jackson, 2009; Spencer, 2009)? Second, as far as we could identify, few of the educational researchers studying the perspectives of successful African American learners examined closely the nature of classroom interactions. A more intentional focus on how students accomplish success (e.g., develop conceptual understandings of mathematics, develop robust mathematical identities) in the classroom as well as in other contexts could lead to specifying more concretely forms of instructional practice that support, or do not support, African American learners. More generally, in the absence of detailed accounts of interactions, it is tempting to attribute success to psychological traits of individuals, like "self-motivation" (Gresalfi, Taylor, Hand, & Greeno, 2008). Although we do not doubt that individuals' motivations, interests, and so forth are important to experiencing success in mathematics, we maintain that success (and failure) are produced as individuals interact with others in context.

Discussion and Conclusion

Our goal in conducting this literature review was to synthesize the available mathematics education research literature regarding how to support African American students' substantial participation in classroom mathematics instruction aimed at rigorous learning goals, since the publication of the 1989 NCTM *Standards*. A central motivation was to evaluate the extent to which the existing research base is able to suggest forms of practice likely to support improved learning opportunities in mathematics for African American students. Our review has revealed some areas of promise. For example, a new subfield has arisen in the last decade or so concerning the study of African American students who experience success in mathematics. However, our review has also revealed the substantial limitations of the current research base particular to supporting African American students' learning of mathematics. A significant amount of research remains to be done if the field of mathematics education is to generate empirically grounded answers to the question raised in our interview with Ms. Mackey: How can teachers better support African American students in classroom instruction aimed at rigorous mathematical learning goals? In general, the available research literature remains at the level of general principles or orientations.

What might a research agenda aimed at specifying forms of instructional practice that support African American learners in mathematics entail? Similar to the questions by which we organized the review, we suggest that it focus on three related areas: (a) teachers' orientations to teaching African American students mathematics, (b) forms of instructional practice that support African

American students to participate in rigorous mathematical activity, and (c) African American students' experiences as learners of mathematics, including the development of their mathematical identities. Methodologically, answering questions aimed at unpacking the *how* of supporting African American students in mathematics necessitates close analyses of interactions in context. Research is needed that investigates in detail the mechanisms by which particular actions, or forms of practice, support (or do not) African American learners.[8] Studies of teaching need to be connected to studies of African American students' learning of mathematics, including the extent to which they are developing productive mathematical identities. This entails explicit discussions of learning goals for African American students and careful study of the mechanisms by which those learning goals are accomplished (or not). In our review, we generally found there was minimal discussion regarding mathematical learning goals for African American youth.

As an example of a set of research questions that would likely help answer the question of how teachers can support African American students to participate in rigorous mathematical activity, consider a study of how teachers create and maintain productive norms in mathematics classrooms that support African American children. Questions might include "How do teachers who successfully support African American students to learn mathematics create and maintain productive norms of, for example, discussing significant mathematical ideas?" "What are the consequences for particular African American students, or a group of students', learning of mathematics?" and "How did those teachers learn to create and maintain productive relationships with African American students?" Answers to questions like these support the decomposition of what teachers do who support African American students. With a better grasp on what practice entails that has been empirically shown to support African American students, it then becomes possible to systematically support pre- and in-service teachers to develop such orientations and forms of practice.

Of course, specifying forms of practice will not suffice for improving the learning opportunities of African American students in mathematics. Research on mathematics teachers' learning suggests that merely specifying forms of practice and offering professional development will not result in sustained improvements across classrooms (Borko, 2004). Instead, accomplishing and sustaining improvement in instruction requires the reorganization of the contexts in which teachers teach. It is therefore crucial that research investigate aspects of the context (e.g., school) that support (or do not support) teachers and African American students to pursue worthwhile mathematical

activity. Tracking (Ballon, 2008; Oakes, Wells, Jones, & Datnow, 1997), the organization of mathematics departments and the opportunities for mathematics teachers to collaborate on the improvement of practice (Gutiérrez, 2000), how teachers and administrators collectively view African American students and mathematics (Jackson, 2009), and instructional leadership (Nelson & Sassi, 2000), for example, influence the nature of what teachers and students do together in classrooms. Systematic research will be needed to detail the salient aspects of the school context that support mathematics teachers to engage with African American students in productive ways.

We anticipate that our deliberate focus on specifying forms of teaching practice could be viewed as counter to what others have found regarding successful teaching of African American students. For example, Ladson-Billings (1995) and Malloy (2009) found that successful teachers of African American students had different "teaching approaches" but shared particular views about students' capabilities and views of knowledge. We do not doubt that teachers who successfully support African American learners may incorporate different practices in their teaching. However, we see little chance at fundamentally improving the nature of learning opportunities in classrooms that serve African American students without explicit attention to the naming and decomposition of the practices of teaching that are shown to be productive. In the absence of such a research base, it is difficult to imagine the possibility of supporting current and future mathematics teachers to improve the learning opportunities of African American students in mathematics classrooms.

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Notes

1. These interviews were conducted as part of a 4-year study designed to address the question of what it takes to improve the quality of middle-grades mathematics teaching at the scale of a large urban district (Cobb & Jackson, in press; Cobb & Smith, 2008). Ms. Mackey is a pseudonym.
2. We describe in the section titled "Competing Lenses: Achievement in Mathematics Versus Opportunities to Learn Mathematics" why we do not focus on studies of African American students' achievement in mathematics unless the studies also concern the nature of opportunities to learn in the classroom. One assumption is that if students substantially participate in classroom activity aimed at rigorous learning goals, they are more likely to develop enduring understandings of mathematics and therefore are more likely to achieve at higher levels.
3. Using African American as a descriptor is admittedly problematic. For example, for No Child Left Behind reporting purposes, students who have emigrated from countries in Africa are identified in school as African American, yet they often have unique histories of education and otherwise. Throughout this article, we use African American to describe people who racially identify themselves or are identified as African American. Recognizing that "race" is a socially constructed category, we follow other educational researchers (e.g., Martin, 2009a, 2009b; Nasir et al., 2009) who suggest that "nonetheless, race functions as an agreed upon set of categories constructed to create and maintain power relations between groups of people. . . . Thus, race is defined not as distinct biological or genetic groups, but rather as a set of social configurations that support particular patterns of access to power and resources" (Nasir et al., 2009, p. 230).
4. Although we are focusing squarely on opportunities to learn in classrooms, we also see value in attending to the relationship between those opportunities to learn and African American students' performance on standardized assessments. We concur with others that the assessments are flawed in many ways, however, at present, assessments often function as a gatekeeper for African American youth and therefore cannot be ignored. That said, we do not view "gazing" at assessment performance without rigorous investigations of the nature of classroom interactions as likely to lead to the improvement of learning opportunities in mathematics for African American youth.
5. We conducted our initial database searches on April 28, 2009. We ran the same searches again on May 9, 2011 to identify any relevant documents that had been published since the initial search that we had not caught in our hand-search of articles. The statistics provided in the Method section reflect our review of pub-

lished documents as of May 9, 2011. Math*" indicates that the search included any descriptor that included "math" (e.g., mathematics, math).

6. There have been a number of dissertations, particularly in the last decade, focused on African American students' experiences of learning mathematics. It is probable that reviewing dissertations would have added substance to the synthesis of the available literature; however, we did not due to our focus on peer-reviewed publications.
7. Some documents would be best located in more than one category. For ease of reference, we placed each document in the category that we deemed best captured its contributions to mathematics education research.
8. We refer the reader to Martin (2009b) and Clark et al. (2009) for a thorough discussion of key theoretical and methodological issues and challenges to consider when centering research on the teaching and learning of African Americans in mathematics education.

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