Challenging Limiting Assumptions

High-Quality Mathematics for Underserved Students

Erica N. Walker

> DIED – Negro Tom, the famous African Calculator, aged 80 years. He was the property of Mrs. Elizabeth Cox of Alexandria. . . . This man was a prodigy. Though he could never read or write, he had perfectly acquired the art of enumeration. . . . Had his opportunity been equal to those of thousands of his fellow-men . . . even a NEWTON himself, need [not] have [been] ashamed to acknowledge him a Brother in Science.
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> —Obituary of Thomas Fuller (1710–1790), cited in Scripture (1891).

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Illustrating the dearth of opportunity for Africans in America to demonstrate their mathematical prowess, the obituary of Thomas Fuller, "Negro Tom," stands as an unfortunate record of limits placed on the expression of African American mathematical genius. And, but for an accident of birth into a "free" American family, the contributions of the well-respected African American mathematician Benjamin Banneker (1731–1806) would have also been lost to history. Fuller's anonymity and Banneker's fame stand in juxtaposition as a commentary on Black potential and achievement in mathematics.

Thomas Fuller may not have needed a teacher to highlight to others his genius in mathematics, but it is clear that his opportunities were limited and constrained by his status as an African slave. This obituary is a poignant one because it gives voice not only to the potentially thousands of other mathematical geniuses who will forever be lost to history, but also to the children living today who are being denied access to their full potential through the mathematics education they receive. Undoubtedly there are Thomas Fullers among schoolchildren, who may either remain unidentified as being talented in mathematics or be known to be mathematically talented but, like Fuller, are constrained by the limits of the system in which they live and are educated. The question many mathematics educators ask, "How can we support the development of mathematical talent for all students, not just a privileged few?" requires that we ask the question "How can we improve equity and access to quality mathematics for underserved children?"

Asking these questions requires mathematics educators, researchers, and others to reconceptualize the discourse about mathematics underachievers, which largely describes their lack of opportunity, participation, and performance in mathematics. Certainly, current reform efforts focused on improving equity in mathematics education are critical to improved performance of African American, Latino/a, and Native American students. However, too often the very real structural and institutional deficits in United States education that have nothing to do with students' potential – save for limiting it – spur the creation of simplistic mandates that focus on curriculum without regard for pedagogy and teaching without regard for learning.

Too often, the equity discussion about mathematics education and the reform efforts it inspires focuses on the number of mathematics courses that students take, whether (and more recently, when) students take algebra, or the availability of Advance Placement courses in mathematics. While these mechanisms are important, they are all essentially indicators of curricular and organizational decisions on which many individuals (especially school district policy-makers, administrators, and teachers) have an impact. These "easily identifiable" equity indicators are signals that equity of access and opportunity *might* exist in a school system or school. But it is not enough to identify these indicators. It is important to examine these indicators in depth to determine if equity is truly present.

Clearly, opportunities for underserved students to learn and do mathematics have dramatically improved since the time of Thomas Fuller. But major educational inequities continue to have a significant impact on mathematics outcomes. In addition, the promise of the Supreme Court's *Brown* decision in 1954 to alleviate school segregation – broadly and narrowly construed – has largely been an elusive one. In deeply segregated schools, students of color and/or low-income students may be less likely to be exposed to highly qualified teachers, extensive resources, or a network of challenging mathematics courses than their White and/or more affluent counterparts. In integrated schools, African American and Latino/a students may find themselves, despite their achievement, tracked into lower-level mathematics courses than their Asian or White counterparts. These experiences reflect lowered expectations and translate into lowered outcomes, ironically approximating the experiences of their counterparts who attend segregated schools that do not offer challenging coursework.

The middle school years, in particular, mark a critical milestone in the educational careers of students. Student entry into the college preparatory mathematics "pipeline" (the sequence of courses Algebra I, geometry, Algebra II, trigonometry, pre-calculus, and calculus) through Algebra I, an important gatekeeper course, is based on a sometimes-arbitrary system of course placement. Students whose parents are well connected, affluent, and highly educated and know how to "work the system" are more likely to be placed in high-level mathematics in middle school, regardless of their test scores. Not only are Black and Latino/a students less likely than White and Asian students to enroll in algebra "early" (in eighth grade or before), but they are also less likely to enroll in algebra in ninth grade.

To my knowledge, no studies have examined the quality of the Algebra I that students receive in affluent, compared with non-affluent, schools, but evidence suggests that the algebra students get in affluent schools is of higher quality. Consequently, non-Asian students of color are consistently underrepresented in the courses that comprise the "advanced" part of the mathematics pipeline in high school: trigonometry, pre-calculus, and calculus. While gaps in algebra and geometry course taking have narrowed as states' and districts' graduation requirements have increased, there is still a gap in the participation of students in the highest-level courses.

Because Black, Latino/a, and Native American students[1] drop out of mathematics earlier and at higher rates than their White and Asian counterparts, the secondary mathematics classroom has been called "one of the most segregated places in American society" by a former president of the National Council of Teachers of Mathematics (Stiff 1990, 152). Any casual observer can see this. Yet many school adults ask, "Why are there so few Black and Latino/a students in advanced mathematics courses?" without considering their own role in this problem.

Even after prior mathematics achievement and socio-economic status are taken into account, Black students, who have similar high school graduation rates to White students, are less likely than their White counterparts to persist in advanced mathematics. Their differential participation has dire consequences for their test scores and other important educational outcomes. Other enriching experiences – mathematics clubs, competitions, and college programs targeting mathematically talented students – are often not options for students of color, since college preparatory mathematics classes are the pools from which these students are drawn.

Although increasing the mathematics requirements for all students is, perhaps, a necessary step, it is not enough. For many years, the number of mathematics courses required to graduate from high schools in most states hovered at around two or three courses. Although these courses were unspecified, it was clear to some (for example, those who were sons and daughters of college graduates) that one had to take certain types of mathematics courses in order to be attractive applicants to colleges.

This is even truer today. Many states and school districts have responded to changes in college admission policies and the SAT – and to the greater attention to equity in mathematics opportunity – by increasing the number of courses required to graduate. But it is still true that students and their parents need critical information in order to navigate these mathematics pathways successfully. Even though the states have bumped up their graduation requirements – some are even listing algebra as a requirement for graduation – none are really making transparent the idea that, in order to be competitive for college admission and to do well on the SAT, there are certain types of math courses that "count."

[1] Additionally, the high national dropout rates for Native American and Latino/a students affect their persistence in mathematics. Nationally, in the 1990s only about 57 percent of Latino/as and 63 percent of Native Americans completed high school. White and Black American high school completion rates are comparable, around 87 percent. Asian American students' completion rates range from 88 percent (immigrant) to 95 percent (native-born) (College Board 1999).

The proliferation of non-advanced mathematics courses in secondary school – and who takes them – bears this out. The importance of taking the right courses is paramount. While a student may be admitted to a decent college without taking calculus, he or she needs to do well enough in courses through pre-calculus to demonstrate the ability to handle college work. If a student's school has a reputation for rigor, then this is probably sufficient. If a student's school does not have this reputation – as many schools that our most underserved students attend do not – a good grade in pre-calculus may be viewed with suspicion, unless it is aligned with a decent SAT score.

Research around reform efforts to improve equity and increase student achievement also targets the need to change teacher behaviors (largely through curriculum and assessment) in mathematics classrooms. Yet, these largely one-dimensional efforts do not critically or emphatically address a crucial dimension of the mathematics classroom: the teacher-student *interaction* in terms of valued norms, behaviors, and instructional practice. Teachers' beliefs about mathematics and who can do it and teachers' expectations about certain students' mathematics ability contribute greatly to the opportunities that teachers provide students in their classroom – and to students' responses (as measured by academic behaviors, for example) to the presence or absence of those opportunities to learn. Certainly, the curricular and organizational mandates designed to enhance instruction are important to examine through the lens of teaching and learning. Teachers are responsible for *enacting* the curriculum; students respond to how the curriculum is enacted.

It is important to note that the courses we mandate are not taught by automatons, nor does school curricular and organizational policy happen in a vacuum. The courses that are offered – and the level at which they are offered – reflect school adults' thinking about the students they teach and what they think those students are capable of. The students sitting in these classrooms are not automatons, either. Their academic and non-academic behaviors – or, equally important, their *perceived* behaviors – affect how teachers structure and deliver curriculum.

In short, student access to quality mathematics depends on what the adults in a system or school think about their students' capacity for learning mathematics. There is substantial evidence – largely anecdotal – that we do not think very highly of the capacity of urban and low-income, ethnic-minority students' ability to do well in mathematics unless they are Asian or Asian American. In my years as a mathematics teacher and educator, I have heard teachers make comments like, "Oh, I could do that problem with my advanced kids but not my low kids," or "Just do the first ten problems – they're the easiest," or "We're not going to cover proofs in this geometry class." When teachers make comments like these, they are making critical decisions about the mathematics content that their students will receive – and about their students!

Because the achievement gap between Black, Latino/a, and Native American students and Asian-American and White students widens the longer they are in the school, it is clear that teachers have a critical role to play. Working with high school teachers to raise their expectations of students' mathematics abilities is an important step in improving mathematics opportunity and outcomes for underserved students. These expectations affect teachers' instruction and curricular choices in ways that often go undocumented but that are noted by students.

For example, several New York City high school students, participating in a ssession I attended of a youth activism project, reported that their teacher slept during their mathematics class and read the newspaper. "We are really concerned about the Regents,"[2] one said, "but we don't know what to do. We talked to the principal but nothing happened." "I just don't think she wants to teach us," said another. School district officials present during the session suggested that the students tell their parents and have the parents complain to the principal and the superintendent. This session took place in April, near the end of the school year.

If these choices that teachers make about instruction were quantified in some way, undoubtedly these decisions could explain some of the gap in mathematics performance we see between Black and Latino/a students, on the one hand, and Asian and White students, on the other. On occasions too numerous to count, I have heard teachers and administrators say that "these kids" just aren't motivated, that they have difficult home lives, that their parents don't care, or that they don't have anyone to help them with their homework. Regardless of whether or not these statements are true (they are largely unsupported by fact and reflect pervasive societal stereotypes – for a counter-narrative, see Walker, forthcoming), it is curious that the response is often to offer less in terms of mathematics instruction instead of more.

Examining instructional practices, and the often unspoken statements which give rise to them, is critically important. These practices and beliefs speak volumes about who we think can do mathematics, and only by addressing them can we address educators' roles in perpetuating Black, Latino/a, and Native American under-representation among mathematically proficient students. I present two examples from my own research that illustrate how such practices can adversely affect equitable mathematics education (elements of this section appeared in Walker 2003).

- In one urban school district, students are tested to determine entrance into honors mathematics courses. Although there is a substantial Spanish-speaking population, students who enter the district and speak only Spanish are expected to enroll in a "transition" general-level mathematics class. Further, they are not allowed to take the entrance exam in Spanish.

[2] The Regents examinations are high-stakes tests that students take in New York State to determine eligibility for the prestigious Regents high school diploma.

- A Black student excelled in her general-level algebra course. At the end of each quarter, students were evaluated, on the basis of grades, to determine if they should be moved into a higher- or lower-level course. When an administrator asked why the student had not been moved to a higher-level course, her teacher replied that she needed the student to remain in the course because she was a good influence on, and a good role model for, the other students in the class (who were predominantly Black and Latino/a).

Both examples are rooted in limiting beliefs about the potential and need for high mathematical performance of students of color in mathematics. The first example is common practice in many school districts. The implicit assumption that all students who enter school from Spanish-speaking countries need remediation in mathematics does not allow for the possibility that one could be Spanish speaking and mathematically proficient. It reflects that these students' teachers and administrators think less of them. Not allowing students to test in their language to determine course placement, particularly for mathematics, seems to ensure that these students are consigned to showing poor performance in mathematics. For placement purposes, it is perfectly logical to test entering students in their native languages to determine their mathematical abilities, without the confounding element of testing their English also.

The second example perniciously assumes that the Black mathematics student's sole importance is to help the teacher maintain order in the classroom. In essence, the teacher deemed that it was more important for the student's meritorious achievement in mathematics to help the teacher than to advance the student. Such practice holds the student back – contributing, despite the student's excellence, to continued under-representation of Black students in high-level mathematics classes.

Most disturbing is that these examples, like many school, administrator, and teacher practices, can have cumulative and long-lasting effects. Although there are many examples of students of color who have persisted in mathematics despite such discouraging experiences, these kinds of obstacles must be removed.

Various institutional issues related to equity (e.g., funding disparities, teacher shortages) often result in urban school students being taught mathematics by teachers who are less qualified and more inexperienced than those who teach in suburban schools. Thus, urban school students (who are overwhelmingly Black and/or Latino/a) often receive mathematics instruction centered on basic skills and repetition rather than instruction that provides them with opportunities to learn and exercise higher-order thinking skills. When computers are present in their schools, for example, they may be more likely to be used for basic skills rather than for mathematics exploration or enrichment.

Although learning basic skills is necessary, this should not be the upper limit of what is expected from Black, Latino/a, and/or Native American students. Regardless of the curriculum in place, teachers make decisions every day that affect what kind of mathematics their students receive. If they think their students "deserve" or are entitled to quality math instruction or rote repetitive tasks, then that is what their students will receive. This "pedagogy of poverty" (Haberman 1991) that many teachers practice can hamper their own development as quality mathematics teachers for all students and adversely affect the performance of their students.

Excellence in mathematics instruction requires attention to both *macro* curriculum and organizational issues as well as *micro* teaching and learning issues. Excellent teaching has never been solely defined as the ability to work well with students who have had every advantage. The true test of good teaching should be reflected in a teacher who can teach students in such a way that they excel in mathematics – despite students' having received poor instruction before, despite what the teacher and others may see as limitations in students' home lives, and despite what is seen as a lack of motivation. There should not be the expectation of a "magic bullet" curriculum – again, recognizing that teachers and students are active agents in the instructional process. We must not expect that every good teacher teach from the same textbook in the same style.

Good teaching for underserved students *can* be done and *has* been done, as outlined by Vanessa Siddle-Walker (1996) and Theresa Perry and her colleagues (2003) in their narratives about schooling for African Americans in the Civil Rights era and as revealed in numerous secondary schools that have high percentages of high-achieving students of color. We need to highlight schools like this; examine carefully their curriculum, organization, pedagogy, and instruction; and use this information to improve outcomes for underserved students. We should also note that, for years, it was believed that girls could not do mathematics. Girls did not score particularly well on standardized tests and did not take high-level courses at the same rates as boys. But, with some attention paid to social and cultural issues and expectations, girls now take and achieve in mathematics courses at similar rates to boys.[3]

Teachers themselves are products of societal messages about mathematics and competing schools of thought about how it should be taught. In the United States, there is a prevalent view that people who do well in mathematics do so "naturally." Consequently, unlike other disciplines that we believe require hard work – good writing can be developed, for example – our societal emphasis on mathematics as a "difficult" subject in which we expect few people to do well hampers our development of mathematically gifted and, I would argue, mathematically proficient people. We accept underachievement in mathematics by all as a natural state of affairs, unlike other countries that expect all students to "master a level of mathematical understanding equivalent to that attained by only our best students" (Vetter 1994, 7).

If teachers do not believe that any of the students in their class can be as smart as they are, it affects how and what they teach those students. We also have to recognize that, in the current mathematics reform climate, teachers are being sometimes cajoled – and, more often, required – to rethink mathematics instructional practice as a participatory endeavor targeting

[3] This point is considerably more complicated than outlined here, but space limitations do not permit a lengthy discussion.

all students. This requires a major paradigm shift on the part of most teachers, because it is wholly different from the ways in which most of them were taught. Quality mathematics has only recently become the supposed school site of democratic practice; until very recently, it was considered to be the purview of the elite students who were exceptional – and, at the very least, going to college.

When we consider instruction, then, it is imperative that we note that teachers' beliefs, knowledge, and attitudes about the subject matter and how to teach it are filtered through their beliefs about students and their potential. Providing equitable instruction for students will require that all of us – researchers, educators, policy-makers, teachers, parents, and administrators – consider, examine, and address the embedded relationships between what is done in the classroom and our expectations of students, their performance, and their possibilities. Without this work, we will continue to enact piecemeal solutions to a complex problem, and equity will continue to elude underserved students.

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