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A National Dilemma: African American Students Underrepresented in Advanced Mathematics Courses

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ABSTRACT

A lack of access to educational opportunities has been a reality for African American students. As a result, America's schools are facing a national dilemma. African American students are significantly underrepresented in advanced mathematics courses. One of the most segregated places in American society is the mathematics classroom. African American students have less access to advanced study in mathematics than before the mid-1960s. Research by Powell (1990) does suggest that inadequate career guidance in high school contributes to the under-participation of African American students in science and mathematics. The authors believe that teachers and administrators must exhibit high expectations and provide opportunities for African American students in advanced mathematics courses.

Introduction

One of the most segregated places in American society is the mathematics classroom. Remedial math classroom contain disproportionate number of Black students, while algebra, geometry, and advanced math classes mainly serve White students (Johnson, 1984). Most Black students cannot take advantage of career opportunities in science and the technologies because they lack knowledge and skills in higher mathematics (Croom, 1984).

The purpose of this article is to research the lack of African American students enrolled in advanced mathematics courses. Researchers have found that, in general, students who are poor, female, and minority tend to have lower achievement than that of other students. Although gender differences are lessening, they still occur (American Association of University Women, 1998). According to Oakes and Lipton (1999), some of the mathematics problems of minority students can be effectively taught higher-level courses as algebra and advanced mathematics. Particularly for minority students, algebra has been identified as a key to higher mathematics and success in college (Moses & Cobb, 2001). Singh and Granville (1999) found that the SES of minority students significantly influenced whether they enrolled in algebra courses.

Significant Contributors to Mathematics Achievement

Peng and Hall (1995) conducted a multiple-regression study on the NELS:88 data and found that the most significant contributor to mathematics achievement was race and ethnicity; gender and father's occupation also contributed significantly. An NCTM task force reported that the mathematics achievement of students at the poverty level was significantly lower than that of more affluent students (NCTM, 1989). Also, a vast amount of research reports that attitude toward mathematics affects achievement. In addition, many researchers have found a negative effect of mathematics anxiety on achievement (e.g., Hembree, 1990; Wigfield & Meece, 1988).

Lack of Participation in Science and Engineering Disciplines

One of the primary reasons for the lack of participation in science and engineering disciplines for African Americans is their lack of academic preparation on the pre-college level. As a consequence, on the college level there are fewer African American students applying for entrance into college with competitive standardized test scores or grades that would even allow them the opportunity to major in more quantitative (non-traditional) science degree programs (Hrabowski, Greene, & Greif, 2002a). In addition, African

American students are more likely to encounter poor quality science instruction compared to White students (Atwater, 2000) and lack of adequate preparation (Hrabowski, 2002b) on the pre-college level. It is important to note that high school course-taking patterns, (Brown, 2000) as well as the number of science and mathematics courses taken during pre-college years (Ellis, 1993), have a significant impact on a student's persistence in science at the post-secondary level and beyond (Brown, 2000;Russell and Atwater, in press).

Unfortunately, African American students in education today often experience a low-level, watered-down curriculum, negative perceptions about their ability, and low expectations regarding their achievement (Gamoran, 1992; Oakes, 1985; Page, 1987; Wheelock, 1992). It is also critical to address the role that subtle racism plays in dictating school administrators and teachers' beliefs, as well as their expectations and perceptions about "who will, who can, or who should do science." Moreover, the power and influence of the middle-class, affluent, and more privileged parents plays an important role in deciding who will be in "their kid's classes" (Kohn, 1998). More often than not, political pressure from parents coupled with low expectations for African Americans in the classroom by teachers, counselors, and administrators result in homogeneous tracks and ability groups (Kohn, 1998; Oakes & Wells, 1997).

Achievement and Discipline of African American Students

In schools today the "hidden curriculum" explicitly or implicitly perpetuates the ideology that science and mathematics are "white male" subjects (Hrabowski, Maton, Greene, & Greif 2002a) where the white, middle and upper class children (often labeled gifted and talented) are exposed to an enriched curriculum. On the contrary, African American students in the same school are overrepresented in school discipline systems (Ferguson, 2001; Gregory & Mosley, 2004) and are more likely to be placed in special education courses or labeled learning disabled. Furthermore, students who are considered low achievers are more likely to be disciplined in school (Leone, Mayer, Malmgren, & Meisel, 2002). Although it is believed the scope of this research there needs to be more research focused on direct correlation between the disciplining of African Americans, which is totally disproportionate to that of White and Asian students (Gregory & Mosley, 2004). Research demonstrates that there are definite correlations across racial and ethnic lines between the achievement and discipline of African American students (Gregory & Mosley, 2004). Not to mention the relationship between students who are consistently in the discipline pipeline, delinquent behavior, and the penal system (Ferguson, 2001).

Fewer Expectations for African American Students

Teachers and administrators exhibit lowered expectations, provide fewer opportunities for exposure to science and mathematics role models, and offer less encouragement towards the enrollment of African Americans in advanced mathematics and science courses, as well as college preparatory tracks, in general (Atwater, 2000; Catsambis, 1995). Simply put, until African American students on the pre-college level are participating at the highest levels in more rigorous, challenging science and mathematics courses, the achievement gap will only become more pronounced. Although African Americans have increased their participation in the sciences within the last decade it is important to note that these advances are still miniscule when compared to those of White students. Research by Brown (2000) and Russell & Atwater (in press), demonstrated that African American students who participated in higher level or advanced science and mathematics courses during high school felt more prepared academically to pursue biology degrees at a predominantly white institution. It is also well known that students who participate in more advanced science and mathematics courses during high school are more likely to perform well on specific subject tests in these courses (Carnov, 1994). On the other hand, it is important also to note that African American students who seem to be successful in science and mathematics during elementary and middle school years often lose interest and confidence as they approach the high school years (Clewell, Anderson, & Thorpe, 1992). Unfortunately, there are few studies to date that have focused on the correlation between African American students' under representation in science careers and degree programs and their high school mathematics and science course-taking patterns (Connell & Lewis, 2003). Research by Powell (1990) does suggest that inadequate career guidance in high school contributes to the under-participation of African American students in science and mathematics courses. Poor guidance counseling early on can have long-term effects and adversely impact career choices in the sciences for many African American students who find out too late that they lack necessary prerequisite courses to pursue degree programs in the sciences on the college level. Moreover, in the event that African American students do enter college degree programs in the sciences many encounter challenges that discourage their persistence both in and out of the classroom often causing them to change their majors or transfer out of their programs (Brown, 2000; Hrabowski, Maton, Greene, & Greif, 2002a).

Track Placement

Students from low-income backgrounds and people of color (primarily African Americans and Latino students) are consistently left out of classes for the gifted and talented or advanced (Oakes & Lipton, 1990c). African Americans in particular are rarely placed in courses that would enable them to pursue careers in science (Malcom, 1990;

Powell, 1990). Furthermore, the opportunities for African Americans to continue in the pre-college "science pipeline" are limited based on the unequal allocation of funding and educational resources provided to schools with high expectations of people of color (Oakes, 1990b). Students are also exposed to a different type of instruction and curriculum (Oakes, 1985; Oakes, 1990; Persell, 1977) based on their track placement. In addition, African Americans are more likely to be placed in vocational educational programs that train for low status occupations (Oakes, 1985, 1990a, 1990b). Subsequently, tracking and ability grouping that result in unequal access to challenging courses (Darling-Hammond, 1995; Oakes, 1985; 1990a; 1990b) helps explain the significant gap in achievement between African American students and White students. Unfortunately, many disillusioned researchers still fail to see the obvious relationship between race, class, gender and tracking (Fieldler, Lange, & Winebrenner, 1993; Kulik & Kulik, 1992, 1982; Tieso, 2003) and the adverse effects of tracking and ability grouping practices.

African American students take fewer algebra and geometry courses than white students and these courses are often "gatekeepers" to science and mathematics degrees and performance on standardized examinations (Powell, 1990). Moreover, African American students are twice likely to be placed in non-academic track classes and remedial mathematical classes (Rees, Argts, &Brewer. 1996; Wheelock, 1992). Placement in these classes exposes students to a less challenging curriculum and the least experienced teaches (Rubin & Noguera, 2004'Wheelock, 1992). According to Wheelock (1992), in some school with a labeled "high track", a disproportionate number of white, middle class students have a curriculum that is designed to prepare them for college. On the other hand, predominately African American schools within the same district offer a significant number of remedial classes as opposed to advancement placement courses (Wheelock, 1992). American schools must accept the challenges of instructing African American students. The next century must reflect an upswing in the success of student learning in the African American community (Johnson & Kritsonis, 2006).

Concluding Remarks

In conclusion, studies indicated the lack of African American students in advanced mathematics courses. African American students often avoid science and mathematics courses and consider these courses insignificant and meaningless to their daily lives (Powell, 1990). Moreover, based on cultural expectations, many African Americans perform poorly in science and mathematics and this is often attributed to a social-psychological phenomenon known as "learned helplessness" (Powell, 1990). According to publications by the U.S. Department of Education (1994), a rigorous mathematics curriculum improves students' performance on standardized examinations. Students who fail to acquire a significant number of what are considered "critical filter" courses like algebra, geometry, and chemistry, are practically eliminated from a number of science careers (i.e. engineering, psychology, and physical science) (Anderson, 1990). In

addition, standardized examinations are primary factors in determining future educational or career choices and students with exposure to the advanced "gate-keeping" courses during pre-college years have greater access to the scientific "pipeline" after high school (Oakes, 1990a, 1990b), and have opportunities to perform better on standardized examination. We recommend educational leaders make a concentrated effort to increase the enrollment of African American students in advanced mathematics effective immediately.

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