THE DIVERSITY BACKLASH AND THE MATHEMATICAL AGENCY OF STUDENTS OF COLOR[*]

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This paper argues that discussions of diversity often avoid the issue of race. Further, it maintains that diversity and structural backlashes to it in the United States in social and economic life shape and are shaped by crises in mathematics education. Attention is paid to the lack of instructional diversity in mathematical problem types and to the mathematical achievement of African American and Latino middle-school students. The paper further argues for the importance of the category of intellectual agency, an under-theorized and under-researched psychological phenomenon in mathematics education, particularly in the literature on minority-student achievement. The paper concludes with preliminary data to show the promise of this line of inquiry for researching the development of mathematical ideas and forms of reasoning among a diversity of students.

The notion of human diversity evokes a wide range of ideas, including apparent and subtle variance among cultural groups; celebration, or at least tolerance, of differences; enrichment of social, economic, academic, and cultural life through incorporating commensurable elements of the other's ways into one's own, and so forth. The content of recent discourse on diversity as an intellectual category as well as scientific, social, and cultural phenomena are by and large virtuous and affirmative. Since the victories of anti-colonial and various civil-rights struggles, diversity in the social sphere has evolved to tolerate and even celebrate both essences and preferences within, for instance, categories of ethnic, socioeconomic, racial, and gender variety as well as expressions of, to name a few, sexuality and intellectuality.[1]

In the United States of America, for example, the ideas and actions of proponents of diversity have influenced researchers and educators of mathematics education as well as educational policy makers. Many national and local initiatives have focused the attention of the mathematics education community to the needs of an increasingly diverse population of students. A significant case in point is one of the several

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[1] The research program, ethnomathematics has championed inquiry into the history of mathematical cognition, including the development of mathematical ideas and forms of reasoning, among a diversity of identifiable cultural groups from decidedly political perspectives (D'Ambrosio, 2001, 2004; Knijnik, 1996, 1999, 2002; Knijnik, Wanderer, & de Oliveira, 2004; Powell, 2002, 2004; Powell & Frankenstein, in press, 1997).

Centers for Learning and Teaching funded by the National Science Foundation. It awarded a five-year grant of 11.3 million dollars in the fall of 2001 to a consortium project based at a large Midwestern university, whose project is known as "Diversity in Mathematics Education." The project is founded on the recognition that the United States needs to attend to certain immediate, urgent challenges based on parallel changes occurring in the instructional workforce and the student population. The specific changes are stated in its press release of October 2001:

> Over the next decade, the nation's schools will have to replace more than two thirds of the teachers currently teaching. More than half of the university faculty in mathematics education will be eligible for retirement in the next two years and almost 80% will be eligible for retirement in the next 10 years. Over the same period, America's K-12 student population and the next generation of leaders and teachers in mathematics education will become more ethnically and linguistically diverse. (Diversity in Mathematics Education/Center for Learning and Teaching, 2001, 3 October)

This consortium project seeks to address the increasing ethnic and linguistic diversity of students, teachers, and mathematics education leaders. It is interesting to note that this use of diversity to signal ethnic and linguistic variation has gained currency in current discourse on diversity. That is, in the US, at least, the category of race is often disassociated from notions of diversity. We speak of ethnic and linguistic diversity without mentioning the category of race, as in the above quote, even though differential achievement rates in mathematics among different racial groups persists and has worsens. (Evidence for this point will be discussed below.) The discursive tendency to omit race from consideration of diversity in American education signals an apparent desire within the dominant culture to avoid talking about a prickly reality and, in this sense, represents what we view as a diversity backlash. That is, the use of the notion of diversity to circumvent grappling with the social and political realities of race. "Race" as a social concept is real in its consequences, especially within American society's education system where racial and ethnic segregation persist.

Concurrent with the challenges of diversity that the consortium project highlights, the United States suffers from twin interacting crises of the mathematical achievement of its students and of the effectiveness of its mathematical instruction. These crises are especially profound in communities of students of color, especially among African American and Latino students and, as we will argue, supported by a structural backlash against diversity of a certain sort. This diversity backlash presents a significant challenge to social actors—such as, mathematics educators and researchers as well as to students and their families—interested in increasing the mathematical achievement of African American and Latino students. We would like to suggest that research into the mathematical agency of students of color promise to contribute theoretical perspectives, research methodologies, and pedagogical approaches that can address the instructional, racial, and ethnic dimensions of the crises in US mathematics education.

These crises in mathematics education are enmeshed in social and economic realities. While cultural diversity and tolerance are championed, there is a rather strong adverse and, sometimes, violent reaction among some sectors of society toward diversity of race, economic, and social structures. This is part of a backlash to affirmative discourses on diversity such as the debates surrounding affirmative action in the workplace and college admissions. The crises have particularly sharp and pervasive effects on the academic attainment of students of color, particularly African American and Latino students. To discuss the twin interacting crises, we first highlight an aspect of the instructional crisis and then the crisis in mathematical achievement.

CRISIS OF INSTRUCTIONAL DIVERSITY IN MATHEMATICS

Diversity or rather the lack of diversity is an aspect of the instructional crisis in US mathematics education. The most compelling evidence of the underachievement in mathematics of American children comes from the 1995 and 1999 TIMSS studies (Hiebert et al., 2003; Stigler, Gonzales, Kawanaka, Knoll, & Serrano, 1999). In these studies, the mathematical knowledge of US students has ranked low among industrialized, "democratic" countries (Hiebert et al., 2003; Stigler et al., 1999). To understand how this might be related to instructional practices, in 1995 and 1999, studies were implemented, using videotape data from a probability sample of eighth-grade classroom in several countries. The 1999 TIMSS Video Study sampled 100 eighth-grade classrooms in each of seven countries: Australia, Czech Republic, Hong Kong SAR of the Peoples Republic of China, Japan, the Netherlands, Switzerland, and the United States. Compared to the six other countries in the TIMSS 1999 Video Study of mathematics teaching, a follow-up and expansion of the 1995 video study, eighth-grade students in the United States scored, on average, significantly lower than their peers (Hiebert et al., 2003). Researchers have analyzed the video data to understand what instructional features might explain differential achievement.

The findings more than anything else underscore the complexity of mathematics teaching. The countries that exhibit high levels of achievement on TIMSS have many similarities and differences in their eighth-grade instructional features. None of the high-performing countries use the same admixture of teaching methods in the same proportions. For example, although both Japan and the Netherlands perform at high levels on TIMSS, the average percentage of problems per eighth-grade mathematics lesson that involved procedural complexity differed radically. Nevertheless, eighth-grade mathematics teaching in all seven countries shared common features of teaching eighth-grade mathematics. Among them we note that "in all the countries at least 80 percent of eighth-graders' lesson time, on average was spent solving problems" (Hiebert et al., 2003, p. 42).

Besides similarities, discernible variations also exist across the countries in teaching eighth-grade mathematics. In particular, the lack of diversity of implemented problem types stands in poignant contrast in US eighth-grade mathematics classrooms. In most debates about instruction, mathematical problem types are dichotomized: basic computational skills and procedures (or using procedures problems) are placed in opposition to rich mathematical problems that focus on concepts and connections among mathematical ideas (or making connections problems). Classrooms in all of the countries spend time both on problems that call for using procedures and on those that call for working on concepts or making connections. The percentage of problems presented in each category, however, does not appear to predict students' performance on achievement tests. Rather what higher-achieving countries share is the way in which teachers and students work on problems as the lesson unfolds. Expect for the US, the six other nations spend between 8% and 52% of classroom time on making connection problems implemented as such (Hiebert et al., 2003, pp. 103-104). Whereas, in US classrooms, making connections problems as lessons unfold are transformed into procedure problems. That is, only US eighth graders spend nearly all of their time practicing only mathematical procedures (Hiebert et al., 2003, pp. 103-104) and rarely engage in the serious study of mathematical concepts. From the 1999 TIMSS Video Study, it is apparent that diversity of implemented problem types does not exist among the sampled US eighth-grade mathematics classrooms.

CRISIS OF MATHEMATICAL ACHIEVEMENT AMONG DIVERSE RACIAL GROUPS

International assessments, particularly those that innovatively combine quantitative and qualitative data collection and analyses, such as TIMSS, provide rich information and revealing findings but do have limitations. At this stage in development of such research tools, they do not provide a window into the differential attainment among different social, economic, gender, racial, or ethnic groups within a nation. In the United States, The National Assessment of Educational Progress (NAEP), also known as "the Nation's Report Card," is the only nationally representative and continuing assessment of what American students know and can do in various subject areas. Since 1969, assessments have been conducted periodically in reading, mathematics, science, writing, U.S. history, civics, geography, and the arts.

Recently, the National Center for Education Statistics of the US Department of Education (National Center for Education Statistics, 2000) published a report titled *NAEP 1999 Trends in Academic Progress: Three Decades of Student Performance*. The NAEP data reveals trends in educational achievement among White, Black, and Latino students. Interesting patterns can be discerned when the data is viewed from the perspective of the wake of the civil rights movement in the United States and the post-civil rights movement. If we define wake of the civil rights movement as occurring between the years 1970 and 1990, and the post-civil rights movement as occurring after the 1980s, then the NAEP data on educational achievement reveal an important manifestation of the structural backlash to racial diversity. For instance, between 1970 and 1988, the educational achievement of Black and White students narrowed by one half or more (NCES, 2000, p, 108). However, since 1988, the gap has been flat, or in some subjects, is wider (NCES, 2000, p, 108). Comparing Latino and White students between 1970 and 1990, the differential in educational achievement narrowed by one half or more, but sadly since 1990, the gap has been flat, or in some subjects, is wider (NCES, 2000, p, 108).

What does the NAEP data indicate about the differential achievement in mathematics among US students concerning racial diversity? Nationally, in 2003, eighth grade African American and Latino students lagged behind their White peers in mathematics. Mastery of school mathematics up through the end of eighth grade was measured on a three-part scale: below basic, basic, and proficient to advanced. African American and Latino children scored at a level of proficient to advanced 12% and 14% of the time respectively, while white students scored at this level 39% of the time. Similarly, 39% and 43% of African American and Latino children scored at a level of basic or better. White children achieved this level 74% of the time. Only 26% of white children scored below basic on this test, as opposed to 61% and 57% of African American and Latino children respectively. Unless genetic causes are assumed, these differential achievements can perhaps be explained by a structural analysis of the political economy of the US society. Whatever non-biological accounts one accepts as explanatory of the paucity of high achievement in school mathematics by African American and Latino students, the continuance of present achievement trends points to an eventual narrowing of diverse participation in the intellectual life of a nation.

LOCAL DAMPENING OF RACIAL DIVERSITY

Data that compare academic achievement of African American and Latino students, on one the one hand, and White students, on the other hand, exist within the economic and social nexus of life in the United States. Mathematical achievement simultaneously shapes and is shaped by interactions between social and economic forces. Estimates are that 40% of all African American children live in poverty, are the least likely to have access to high-quality education (Patterson, 1997), and have a rather small possibility of enjoying mathematics instruction that reaches beyond the procedural.

During the economic recession of 2000-2003, the unemployment rate in urban centers in the US rose sharply. In New York City, for instance, the increase in unemployment was worse for men than for women, and particularly acute for black men. This reality is revealed in a study by the Community Service Society (Levitan, 2004), a non-governmental organization that fights poverty in New York City and struggles to strengthen community life for all. Based on data from the federal Bureau of Labor Statistics, the study reports on the employment–population ratio—the fraction of the working-age population with a paid job. It found that in 2003 only 51.8% of African American men between the ages 16 to 64 held jobs in New York City. The rate for white men was 75.7%; for Latino men, 66.7%; and for black women, 57.1%. The employment-population ratios for African American and Latino men were the lowest since 1979. According to Scott (2004), economists admit that these findings are consistent with trends in the racial gap in male employment of other Northern, Midwestern, and Central cities where manufacturing jobs have disappeared in recent decades. Such a reality underscores a structural backlash to diversity within the US society. That is, if unemployment trends continue in their current direction, the economic and ultimately the biological viability of certain racial and ethnic groups will become precarious, at best, and most certainly, decrease significantly racial diversity in high levels of schooling as well as other facets of social and economic life.

MATHEMATICAL AGENCY OF STUDENTS OF COLOR

In the US, despite the academic underachievement of many non-White students and the relative economic poverty of their communities, in their early scholastic career, students of color express pleasure with mathematics. Martin (2000) notes that studies have found that "African American children consistently express the most positive attitudes towards mathematics among all student groups and identify mathematics as one of their favorite and most important subjects" (p. 12). Martin's research suggests that African-American parents and community members express also beliefs consistent with dominant societal folk theories of mathematics learning. However, their life experiences are such that at the same time they express beliefs that reflect perceptions of their limited opportunity to participate in mathematical contexts as a result of differential treatment based on their African-American status. Notwithstanding positive attitudes toward mathematics, when researchers examine the course-taking and persistence patterns in predominately African-American high schools, 80% of the students take no more mathematics than what is minimally required to graduate (Martin, 2000, p. 15).

Explanation and insight are required into ways to ameliorate this striking discrepancy between early positive attitudes and identification with mathematics and subsequent failure and avoidance of it. Martin observes that

> Because few studies have focused on academic success among African-American students and fewer have focused on students who do well in mathematics, issues of individual agency, success, and persistence remain largely underconceptualized. Success, for example, has been defined only in terms of external measures such as grades and test scores, and persistence has been defined only in terms of course-taking patterns. (p. 28).

We consider critical Martin's point about individual agency and view agency as potentially pivotal to the involvement of African Americans and other students whose subject position is not identified with the dominant culture and to overcoming societal-engendered failure and avoidance of the discipline. Understanding agency is particularly important since both failure and success can be located within the same set of social, economic, and school conditions that usually is described as only producing failure. Avoiding deterministic theories of educational anthropology, urban education, and sociology of education that tend to focus on discussions of culture, ethnicity, stratification, opportunity structure, and African-American status, Martin's conception of agency is informed by Bandura's (Bandura, 1982; 1997) notion that human agency and individual motivation can manifest and prevail in opposition to larger, countervailing forces.

From a similar theoretical position, we have initiated a new, three-year research project, currently in its initial year. A salient question that we propose to investigate concerns individual agency in mathematical problem solving. Under a grant from the National Science Foundation (REC-0309062), we are gathering data and observing students' initiative and ownership of ideas. Our analysis develops from examining student-to-student discursive practices as individual students in collaboration with peers build mathematical ideas and forms of reasoning (Powell, 2003; Powell & Maher, 2002, 2003). We are conceptualizing agency in terms of the mathematical ideas and reasoning evidenced from learners' individual initiative to define or redefine as well as build on or go beyond the specificities of mathematical situations on which they have been invited to work. Learners' use of their agency also manifests itself as they create heuristics to resolve mathematical tasks or aspects of them. This conceptualization recognizes learners' independent and autonomous mathematical performances through student-to-student discourse. It also corresponds to the work of other investigators (Delpit & Dowdy, 2002; Perry & Delpit, 1998) who suggest the need for further research into relations between the discourse of urban, African American students and their academic achievement.

Our study is set in a particular social context. The setting is an informal after-school program at Hubbard Middle School in Plainfield, New Jersey, an economically depressed, urban school district with 98% African American and Latino students. Sixty-four percent of the students of the school are eligible for free or reduced-cost lunch compared to the statewide average of 28% (Education Law Center, 2002). In the Plainfield School District, the high school graduation rate is 52% compared to a rate of 67% in districts of comparable levels of poverty (Education Law Center, 2002).

In our study, we are investigating how African American and Latino students from a low-income, urban community build mathematical ideas and engage in mathematical reasoning in an after school, informal setting. According to Friedman (2002), resources for after school programs throughout the United States merely replicate and extend the curriculum of the school day with "skill and drill" education. In middle schools, this content and instructional approach contributes mightily to the failure and disenchantment of students with mathematics (Stigler et al., 1999; Stigler & Hiebert, 1999). Hence, it would be more than insidious to replicate and extend this approach into the informal settings of after-school programs. The problem of "skill and drill" education is especially acute for low-income students who, as noted by the United States Department of Education (1997, October), finish high school without the rigorous mathematics courses needed for college entrance. Recently, educators and educational policy makers have identified the critical need for opportunities for academic and social development based on student initiative or agency in contexts outside of traditional school hours (National Research Council, 2002; Urban Seminar Series on Children's Health and Safety, 2001). Our research is designed to document student discourse and to promote the exercise of agency by inviting students to engage in meaningful mathematical tasks and to study over time how they change their participation role in mathematics from what Larson (2002) describes as, "overhearers" to "authors" of mathematical ideas and texts.

The content and pedagogy in our research, while consistent with the vision and philosophical perspective of the Plainfield Public Schools, differ substantially from the mathematics curriculum used in the Plainfield schools. The mathematical content of the project focuses on strands in combinatorics, algebraic thinking, and probability, incorporating the use of technology as a tool. A critical difference between the curriculum of the school district and our study is an inevitable result of school realities. Unlike mathematics instruction in public school districts, constrained by administrative, political, temporal, and other limitations, mathematical activities of our study will not be directly affected by the pressures of grading, standardized tests, and curriculum coverage. These non-mathematical constraints affect instruction in ways that can cause even reform-intended mathematics curricula to fall far short of idealized scenarios. Instead, different pedagogical processes guide our work (Maher & Martino, 2000). It is important to note that also unlike mathematics instruction in US middle schools our tasks on which we invite students to work involve making connections and are implemented as such rather than transformed in the unfolding of the session into problems focusing on basic computational skills and procedures (For problem task examples, see Harvard-Smithsonian Institution Astrophysical Observatory, 2000).

The previous longitudinal work of the Robert B. Davis Institute for Learning (Graduate School of Education, Rutgers University) has shown that students use their agency in the direction of greater and successful participation in mathematics as authors of mathematical ideas and texts when the contexts in which students explore mathematical ideas provide challenging problem tasks and when students are given opportunities to think deeply about mathematical situations over time (Harvard-Smithsonian Institution Astrophysical Observatory, 2000; Maher, 2002; Maher & Martino, 2000; Powell, 2003; Speiser, Walter, & Maher, 2003).

INSTANCES OF STUDENTS EXHIBITING MATHEMATICAL AGENCY

Twenty-four sixth graders volunteered to be participants in our study in the context of an after-school mathematics program. The main sources of data are as follows: (1) discourse patterns and other activity of students as they work on mathematical investigations recorded on videotape; (2) students' inscriptions, collected and digitized; (3) researcher and observer notes and reflective diaries, collected and digitized, and (4) research team's planning notes and debriefing session recorded on videotape. Our framework for analysis, developed from earlier work, is discussed in Powell, Francisco, and Maher (2003).

In the first three cycles of our study, there are respectively eight, eight, and six research sessions, each lasting one and a half hours. Here we report on instances of student mathematical agency during the first cycle of our study. In this cycle, we invited students to build physical models using Cuisenaire rods to explore relations among them that evoke certain kinds of reasoning: organizing and ordering by categories, hypothetical reasoning about number relationships (whole number and fractions), proportional reasoning, reasoning by contradiction, recognizing and predicting patterns, and generalizing.

Students engaged in building mathematical models with Cuisenaire rods, a tool with which they had not previously worked. We invited them to work on problems in which a rod of certain length was given a number name and for which they were to find a rod that had a comparative number name of the given rod. For instance, in the first session, after the students were invited to explore the Cuisenaire rods, Lorrin stated that even though her partner suggested that the white rod could be called 2 that she was thinking the it could be called 5. A researcher then asked, "What if you called the white rod 5 instead of 2?" Lorrin replied that the orange rod would be called 50.

In our theorization, an aspect of intellectual agency applied to mathematical learning is taking risks to venture beyond a stipulated situation to explore and further develop a set of ideas. Agency is also manifest when learners develop problem-solving heuristics to address tasks. Such an act requires that learners author their own procedures or strategies. In all instances, we attend particularly to the mathematical ideas and forms of reasoning evidence in learners' discourse and inscriptions as they exercise agency in mathematical situations. Our initial data, collected in the first sessions of our project, provide a preliminary glimpse into the frame of agency and development. The following are three instances:

> Instance I: A researcher invites students to find which rod would be called one-half if the blue rod were called one and further inquiries what they say or do to convince someone of their result. Herman, Malika, and Lorrin each place two light green rods end-to-end alongside a dark green rod. Later, Lorrin places end-to-end two yellows rods and lays them alongside an orange rod. She says, "I'm going to do all of them." She proceeds to find rods whose length is the same as a train of two rods of the same color. As Malika helps, Lorrin tells her, "I'm talking about half and half." In this she seems to mean that her goal is to find all rods whose length can be constructed with two other rods of the same color. Later she separates the rods that can be so expressed from the others Lorrin points to the blue, black, light green, and yellow rods and says that "they don't have halves."

> Instance II: Two sessions later, students continue to consider which rod could be called half of a blue rod. Some reason that the light green rod has a length that is one-third the length of the blue rod. Some students exhibit novel ways to show this, using

multiplication or addition. Jeffrey reasons that the red rod would have the number name two-ninths if the blue rod is one. He later shows the class his model of a blue rod alongside a train of rods in the following sequence: red, light green, red, and red. He then challenges the class to find the number name for the red rod when the blue rod is called one.

Instance III: During the fourth session of the cycle, students were invited to work on the question, "If the blue rod is 1, what is yellow?" Many students manipulated the rods to observe how many white rods they needed to place end-to-end to construct a length equivalent to the blue rod. Malika lists how many white rods make up each of the other rods. She calls the yellow rod 5, and later she and Lorrin say that yellow is five-ninths. Building a model of a blue rod alongside a train of one yellow and four white rods, with a purple rod beneath the white rods, Lorrin and Malika show that the purple rod is four-ninths. The students at their table determine number names for all the rods, except that they are uncertain about what to call the orange rod.

Eventually, this group of students resolves what number name to give to the orange rod. One student remarks that ten-ninths is an improper fraction. A male colleague [off camera] says assertively, "It's still ten-ninths. That ain't gonna change it because it's an improper fraction. That makes it even more right."

In each of the three instances discussed above, students play with a variation on a theme introduced by the researcher and improvise in the sense that they act the given materials and compose ideas without following a prescribed script. Students often posed problems for themselves and for others to solve. In one instance, students initiated an investigation to find which rods have a rod that can be called one-half. Their reasoning indicated that they connected meaning to the symbols they used in their problem solving with rods. Through their actions, observations and reasoning, they progressed in building a foundational understanding of ideas about fractions and their operations, fraction as number, comparing fractions, upper and lower bound, equivalent fractions, proper and improper fractions. Certain earlier "beliefs", such as "the numerator cannot be larger than the denominator " were examined individually and by the whole class, eventually resolved by reasoning from the patterns they observed in the models they built.

DISCUSSION

Our study is in the first year of its project three-year tenure and we are just beginning to analyze our initial data. From our investigation, two of our intended outcomes are the following: fundamental knowledge of the mathematical ideas and forms of reasoning built by African American and Latino youngsters of middle-school age engaged in working on deep, open-ended mathematics tasks in technology-rich, informal settings in a high-needs public school district; and evidence of the mathematical achievement of students of color as a byproduct of their engagement of their agency.

These goals are significant since first and foremost, the notion of being biologically ill-equipped for high cognitive functioning has influenced attitudes and actions toward students of color throughout history (Gould, 1981) and some lay people and scientists still promote it (Herrnstein & Murray, 1994). Moreover, some researchers in mathematics education (Orr, 1997) conclude that the linguist structure of African American speech is at fault. Racism has not ended with the successes of the Civil Rights Movement. Rather, as the African American novelist Alice Walker writes, "racism is like that local creeping kudzu vine. It swallows whole forests and abandoned houses; if you don't keep pulling up the roots it will grow back faster than you can destroy it" (Walker, 1983, p. 165). It might be that racism roots itself in our theoretical assumptions, our methodological approaches, our observational lenses, as well as our interpretation of data. Not assuming that students of color have intellectual agency that can be used in the learning and teaching of mathematics may unwittingly derive from certain assumptions about their intellectual capabilities. Whereas, research methodologies that incorporate a focus on the intellectual agency of African American and Latino students in mathematical situations and the mathematical ideas and forms of reasoning develop through the exercise of agency promise to inform the mathematics education community not only about cognitive diversity but also to engender respect for students of color based on evidence of their mathematical intellectuality.

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