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ABSTRACT

This paper is a reaction to a plenary address, "Fairness in Dealing: Diversity, Psychology, and Mathematics Education" by Suzanne Damarin (SE 057 179). The issues of intentionality, institutional and instructional practices, identity development, and assessment are addressed in regard to the Quantitative Understanding: Amplifying Student Achievement and Reasoning (QUASAR) Project, a mathematics education reform project that has been supporting and studying the design and implementation of innovative instructional programs in middle schools serving economically disadvantaged communities. The QUASAR program was designed to address the persistent historical association of poverty and low achievement in mathematics by providing students in schools in low income communities with access to mathematics instruction that heavily emphasizes understanding, reasoning, and problem solving rather than memorization and imitation. One conclusion reached is that, just as it is important for students to develop an identity as knowers and doers of mathematics, it is equally important for mathematics educators to develop an identity as knowers and doers of equity. Contains 21 references. (MKR)

Shuffling the Deck to Ensure Fairness in Dealing: A Commentary on Some Issues of Equity and Mathematics Education from the Perspective of the QUASAR Project

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SHUFFLING THE DECK TO ENSURE FAIRNESS IN DEALING: A COMMENTARY ON SOME ISSUES OF EQUITY AND MATHEMATICS EDUCATION FROM THE PERSPECTIVE OF THE QUASAR PROJECT[1]

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In her plenary paper for this conference, Suzanne Damarin takes us on a "whirlwind journey" (in her words) through the field of feminist research related to mathematics education, with some attention also to critical race theory and postmodernism. Throughout her paper, she reminds us that the relationship between gender and mathematics is an important issue worthy of our attention from a variety of perspectives, and she also attempts to tie gender concerns to those of race and ethnicity. This sampler of feminist and other views can enrich both the study and the practice of mathematics education, and it is likely to make a valuable contribution to a small but growing literature generally concerned with the theme of "mathematics for all."

I am not an expert in the areas of feminist research, critical race theory or postmodernist perspectives, but it appears to me that the expanse of intellectual terrain covered in Damarin's paper is impressive. However, as is often the case when a broad range of topics and perspectives are addressed, the attention to breadth rather than depth results in a paper that suffers in many places from a lack of detail. Moreover, the non-feminist perspectives, such as postmodernism, are offered in a generally uncritical, unanalyzed manner that limits the contribution that the paper might have made in helping researchers in mathematics education understand the power and limitations of these less familiar perspectives. Nevertheless, the paper succeeds in addressing a large number of important issues that are worthy of serious consideration in mathematics education research and practice. I was particularly struck by her characterization of equity as "fairness in dealing," and I was able to find connections between this notion and several issues embedded in work that my colleagues and I have been doing in the QUASAR (Quantitative Understanding: Amplifying Student Achievement and Reasoning) project.

The QUASAR Project

QUASAR is a mathematics education reform project which has been supporting and studying the design and implementation of innovative instructional programs in middle schools serving economically disadvantaged communities. The project was designed to address the persistent historical association of poverty and

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[2] I wish to acknowledge the contributions of Catherine Brown, Ellice Forman, Margaret Schwan Smith, and Mary Kay Stein, each of whom shared valuable insights with me as I prepared this paper, thereby enriching my understanding of the issues discussed herein. I am also grateful to Barbara Grover, Suzanne Lane, and Maria Magone for their comments.

low achievement in mathematics by providing students in schools in low income communities with access to mathematics instruction that heavily emphasized understanding, reasoning, and problem solving rather than memorization and imitation.

Located in urban school districts, project schools serve a culturally and linguistically diverse set of students. Aggregated across all QUASAR schools, about half the students are African-American, about one-third Latino/Latina, and about one-eighth Caucasian. The patterns of ethnic distribution within the school population vary across sites, with two schools serving predominantly African-American students, two primarily Latino/Latina students, and the other two having student populations that are internally ethnically diverse. Linguistic diversity is also found in many QUASAR schools. In fact, most schools serve large subgroups of students for whom English is not the primary language spoken at home; in two schools, that group is the majority. Although there is considerable diversity with respect to ethnicity and language, there is very little variance with respect to another demographic characteristic: the vast majority of students who attend each QUASAR school live in poverty.

At each QUASAR school, the mathematics teachers and school administrators have been working with "resource partners" — usually mathematics educators from a local university — to enhance the school's mathematics instructional program. Each site team has operated independently to design and implement its plan for curriculum, staff development, and other aspects of the program, so there is diversity across the schools with respect to curricula and forms of support provided to students and teachers, but there are also many similar features that characterize mathematics instruction in QUASAR schools.

Shuffling the Deck: Some Aspects of QUASAR's Pedagogy of Fair Dealing

Three aspects of the instruction found in QUASAR schools are discussed here as they relate to themes developed in Damarin's paper. The notion of intentional focus is discussed first, as it relates to the contrast between QUASAR's focus on a diverse composite (the poor) and Damarin's focus on gender, race or ethnicity subgroups. Next, the repertoire of instructional practices suggested by Damarin to "fix the mathematics" is expanded by looking at instruction in QUASAR classrooms. Finally, the role that such instruction can play in helping students see themselves as knowers and doers of mathematics is examined.

Intentionality

In discussing lines of feminist research and theory that have addressed "fixing the mathematics" rather than "fixing the women," Damarin underscores the point that these researchers argue for the necessity of paying specific attention to girls and women. Somewhat in contrast, the instructional reform activity of QUASAR was undertaken with specific attention to the children of poverty, regardless of gender, race, ethnicity, or language. Thus, the QUASAR target group was more diverse than the groups addressed in most feminist research or in interventions

designed for one particular ethnic, racial or linguistic subgroup. Nevertheless, some (though not all) of the educational approaches used at project sites were adaptations of work that had been developed with a focus on a particular subgroup. For example, one QUASAR site began with an intention to adapt the approaches used in an innovative enrichment program designed for female high school students. At another QUASAR site, the plan was to use curriculum materials that placed a heavy emphasis on visual models; among the reasons for development of the materials was the successful use of such activities with Native American students.

One point seems clear from this brief glimpse into QUASAR. The realities of many educational settings in this country often do not afford mathematics teachers the "luxury" of focus that many of us have in our research and theory. Students, both males and females, may come in several colors, from diverse cultural heritages, and may speak many different languages. Thus, at least some research attention needs to be devoted to the composite mosaic as well as to its components. Although research and theory generated from a perspective of specific focus on a particular gender or cultural group can aid in addressing broader issues, it is unlikely to be sufficient to address all issues of relevance and import to mathematics teaching and learning in diverse classrooms.

Institutional and Instructional Practices

A first step in increasing equity at most QUASAR schools was the elimination of the academic tracking practices that were in place prior to the beginning of the project in 1989. In these schools, as in many similar schools across the country, it had been common for students to be placed in different classes on the basis of test scores and presumed ability. In these different tracks, students either pursued different curricula or studied the same curriculum at different speeds. In general, this practice led to unequal opportunity for students in the lower tracks to pursue courses with higher-level goals and objectives, especially since instruction in lower-track courses tended to omit challenging material (Oakes, 1990). When QUASAR began, the practice of academic tracking was essentially ended at the project sites. As a consequence, all students in the school — including those in bilingual or other "special" mathematics classes — generally received similar instruction.

Once tracking was eliminated, the mathematics classes became more diverse than had been the case prior to the project, and teachers were challenged to develop new instructional approaches that would accommodate more diverse groups of students. Damarin points to a few instructional practices that have been identified as addressing the need to "fix the mathematics" and to connect instruction to the "women's ways of knowing" provided by Belenky, Clinchy, Goldberger and Tarule (1986). In particular, she mentions journal writing as a means of community building and giving students "voice," and several references are made to studies that have suggested the efficacy of cooperative learning for females. In general, in the QUASAR project we have noted the efficacy of these practices and others for diverse groups of students.

Drawing on examples from QUASAR classrooms, Silver, Smith and Nelson (1995) describe the efforts of teachers to develop collaborative discourse communities in their classrooms by using cooperative group work to foster communication and collaboration and by providing mathematics problems that can be represented and solved in multiple ways in order to give students multiple entry points into problem solving. Silver et al. also demonstrate how QUASAR teachers encourage students to engage in and then communicate their own thinking; how teachers support students as they learn to examine each other's reasoning, while at the same time learning both to value different perspectives and to maintain respect for each other as people; and how teachers enhance the "relevance" of mathematics by tying it to students' life experiences, interests, and cultural heritage.

These practices can be seen as related to the notions of "connected knowing" and "constructed knowing" described originally by Belenky et al. (1986) and elaborated more recently by Becker (1995). Some research suggests that these features of what Becker calls "connected teaching" are quite likely to also support the learning of culturally diverse students. In fact, a review of educational practices used successfully with linguistically and culturally diverse student populations (Garcia, 1991) reported that collaboration and communication were key elements of effective instructional practice, especially when the curriculum blends challenging and basic academic content, as is done in QUASAR mathematics classrooms. In order to develop mathematical proficiency in a wider range of students, it is critical to focus not only on alternative modes of instruction but also on appropriate challenging tasks that have the potential to develop students' understandings and capacities for mathematical problem solving and reasoning.

There is evidence that the instruction provided in QUASAR classrooms not only encourages connected knowing in the ways described above but also engages students with challenging mathematical tasks. In particular, an analysis of a representative sample of nearly 150 instructional tasks used in project classrooms over three years, Stein, Grover, and Henningsen (in press) found that about three-fourths of the instructional episodes involved mathematical tasks intended to provoke students to engage in conceptual understanding, reasoning or problem solving. These tasks encouraged students to use mathematical thinking and reasoning—either in connecting procedures to underlying concepts and meaning, or in tackling complex mathematical problems in novel ways. Only about 20% of the tasks were set up and implemented to involve computation or memorization of information without some overt connection to developing understanding. Thus, instruction in QUASAR mathematics classrooms is oriented toward understanding, reasoning, problem solving, and communication to a much greater extent than is found in conventional mathematics classrooms.[3]

It is important to note, however, that within these overall findings there are inter-school and inter-teacher variations that may be important. Not all small group work is likely to be efficacious, nor will all journal writing be enriching. We need

[3] For conventional mathematics instruction, Stodolsky (1988) reported that 97% of the classes she observed dealt with low-level cognitive objectives.

to understand even more about which instructional practices work for diverse groups of students and under what conditions they may be ineffective. For example, using a portion of the classroom observation scheme developed and used in QUASAR (Stein, Grover & Silver, 1991), Murrell (1995) observed several middle school classrooms and concluded that "reform-oriented instruction" often worked in ways that were detrimental to the learning of low-achieving African-American males. Secada (1992) has also provided an account of some ways in which students with limited proficiency in English can be "left out" of the discourse in reform-oriented mathematics classrooms, even when the lesson is being conducted by an exceptional teacher. Thus, Murrell's findings and Secada's analysis, along with the admonition of Delpit (1988) not to repeat the failure of earlier "process-oriented" school reforms, suggest that we need to resist premature declarations of efficacy.

Another reason for caution is the recognition that even the most effective classroom instruction cannot by itself completely overcome the institutionalized prejudice encountered by students in and out of school. Although Suzanne Damarin has chosen to frame equity issues in ways that de-emphasize the power of social class and economic forces in determining much of what happens to students in and out of school, there is no question that we must recognize the power of these structural relations even as we resist the pull toward reductionism and essentialism. In QUASAR schools, students often miss large numbers of instructional days as they and their families struggle with the ponderous forces that act on the urban poor — inadequate health care, housing, transportation, and economic or personal security. And these stresses often result in tremendous instability in the lives of students. Within the group of students completing grade 8 at project schools, only about half are students who have attended the school since grade 6. Furthermore, when QUASAR graduates are denied access to educational opportunities because students from "those schools" are not expected to be "ready" to take "that course," and are subjected instead to mind-numbing instruction devoid of intellectual substance and challenge, the forces of institutionalized racism and class prejudice are clear. In a recent essay, Anyon provided the distilled essence: "Educational reforms cannot compensate for the ravages of society" (1995, p. 88). As we develop theory, research and educational interventions related to equity and mathematics education, we must deal with these forces — the extent to which the "deck is stacked" against fairness in dealing. However, even as we do this, we need to keep in mind individuals as well as institutions.

Identity Development

In her plenary paper, Damarin argues that effective mathematics instruction would allow women to (re)construct themselves as (other than silent) knowers of mathematics. In fact, it is likely that many features of instruction in QUASAR classrooms support a student in developing an identity as a knower and doer of mathematics.

Forman (in press) examined instruction in a QUASAR classroom from the perspective of sociocultural theory, such as Lave and Wenger's (1991) notion of legitimate peripheral participation within a community of practice. She observed

that, in contrast to traditional classrooms, QUASAR classrooms offer students a variety of participation structures, including whole-class discussions, group work, student demonstrations, and individual student-teacher interactions. These varied activity settings, when coupled with the other characteristics of tasks and instruction identified above, are likely to allow students multiple opportunities to participate in knowing and doing mathematics since they can "find their voice" by connecting to one or more of these participation structures. Connectedness is also encouraged in many project classrooms through student writing about their experiences, attitudes, and feelings about mathematics. In most project classrooms, students are asked to write reflections on the understandings and confusions associated with selected lessons or assignments.

Forman (in press) also notes that the forms of discourse encountered in QUASAR classrooms deviate from the familiar "recitation script" associated with conventional mathematics instruction. She points to a variety of ways in which teachers support students to become full participants in a classroom mathematical community by assisting them to learn the linguistic practices expected of a full participant, such as explaining their thinking, providing rationales for solutions or approaches, and coming to understand each other's thinking. As students participate in this kind of scaffolded classroom discourse, they can gradually come to see themselves as members of a community of *knowers and doers* of mathematics (Lave & Wenger, 1991). This contrasts sharply with conventional instructional settings in which students instead learn to view themselves as individuals who are *receivers* of mathematical knowledge created by others who are unknown and unavailable.

The importance of identity formation has also been discussed in related research conducted in out-of-school settings. Heath and McLaughlin (1993) studied community-based youth organizations and the ways in which they help inner-city youth develop a strong sense of self, of empowerment, and of persistence. Heath and McLaughlin concluded that, in order to understand the impact of community-based organizational practices on youth, it is important to consider two frames of reference — objective (or outsider) perspectives and subjective (or insider) perspectives — and they argued that personal identity may be at least as important as matters of race or ethnicity in the lives of children: "Ethnicity seemed, from the youth perspective, to be more often a label assigned to them by outsiders than an indication of their real sense of self" (p. 6).

Although much of the work on mathematics and gender, including *Women's Ways of Knowing*, has benefited from a subjective perspective, when policy prescriptions or research agendas have been derived from this work there has been a tendency to lose the individuality of students in favor of assigning each person group membership and identification. Given the importance of individual identity in human intellectual and social development, it seems critical for us to balance the outsider and insider perspectives in our research as we examine the conditions under which diverse groups of students develop views of themselves as being competent knowers and doers of mathematics.

Is It Really a Fair Game?: Assessing Outcomes Responsibly

The impact of instruction in QUASAR classrooms has been examined by measuring changes in students' mathematical performance over time. Damarin refers to the inadequacy of traditional mathematics tests (e.g., commercial standardized tests) to detect mathematical proficiency in gender-sensitive and race-sensitive ways. Traditional measures of mathematics performance are also generally viewed as inadequate to measure the kinds of high-level cognitive outcomes that were intended to be a special instructional focus at project sites. Thus, the project developed the QUASAR Cognitive Assessment Instrument (QCAI) to assess students' mathematical understanding, problem solving, reasoning, and communication (Lane 1993; Silver & Lane, 1993). The QCAI was developed with attention to various equity considerations, such as potential gender, racial, or ethnic bias in task formats, scoring rubrics and test administration (Lane & Silver, 1995).

A first-order question for the QUASAR project was whether or not students were benefiting in the intended ways. An analysis of QCAI results from the first three project years provided clear evidence that students had increased their capacity for mathematical reasoning, problem solving and communication during that time period (Lane & Silver, 1994). Evidence of changes in students' mathematical understanding, thinking and reasoning over time came from an aggregation of holistic judgments of student performance on a QCAI tasks administered across the years at all three grade levels. In particular, the number of students providing responses judged to be at the two highest score levels more than doubled (from 18% to 40%) between Fall 1990 and Spring 1993. Further evidence was obtained from a detailed examination of responses to a subset of QCAI tasks to reveal growth in students' mathematical understanding, in their use of appropriate strategies, and in the quality of their mathematical justifications.

Is it the case that QUASAR students, regardless of gender, race, or primary language benefit in equitable ways? To examine "fairness in dealing" in the project, a series of analyses have been conducted. Lane, Wang and Magone (1995) examined the performance on all QCAI tasks by male and female students in grades 6 and 7 in two different years, and they found no significant gender difference for 30 of the 36 tasks, thereby suggesting that QUASAR instruction was supporting the learning of male and female students equally well. Males did significantly better than females on only two tasks, and females did significantly better on four tasks. Another analysis of QUASAR data revealed that the gains made by various racial/ethnic or linguistic subgroups of students were generally quite similar to each other and to those found for the total student population (Lane, Silver & Wang, 1995). In particular, at the two schools with samples of African-American and Caucasian students sufficiently large enough to permit examination of annual performance gains for longitudinal cohorts of students, it was reported that (a) the total performance gains were similar for three of the four cohorts, and (b) the gap between Caucasian and African-American students, which was quite large at the beginning of grade 6, decreased significantly for three of the four cohorts and remained es-

sentially constant for the fourth. Similarly, at one school which had a population that permitted such an analysis, the performance of two longitudinal cohorts of Spanish-speaking students receiving bilingual Spanish-English instruction was compared with that of non-Spanish-speaking students receiving monolingual English instruction, and it was found that students in the bilingual classes had performed less well when they entered the program but that the performance gap was substantially reduced or eliminated by the end of grade 8.

A further question might be asked: "Does 'fairness in dealing' actually result from 'fixing the mathematics'?" An answer to this question can be found in another project analysis examining the relationship between instructional processes and student learning outcomes in QUASAR classrooms. Stein and Lane (1995) found that student learning gains were especially positive in classrooms in which instructional tasks consistently encouraged high-level thinking and reasoning and involved multiple solution strategies, multiple connected representations, or mathematical explanations, and that student performance gains were small in classrooms using instructional tasks that were procedural in nature and required only one solution strategy or representation, and little or no mathematical communication.

Although we still need to examine the entire corpus of project data collected over five years, the findings of our analyses to date are encouraging for those of us interested in equity and mathematics education reform. Collectively, these analyses support a conclusion that the features of instruction generally being called for by mathematics education reformers and generally being utilized in QUASAR classrooms can support all students in diverse school populations to improve their mathematical understanding, reasoning and problem solving. The findings are especially meaningful because they relate to both an instructional approach oriented toward *dealing fairly* with diverse groups of students as they learn a *fair deal of mathematics* and an assessment measure designed to be equitable, sensitive to change, and reflective of important mathematical learning outcomes.

Coda

Suzanne Damarin has challenged us to examine how gender and race are both predictive of and predicted by mathematical achievement. I have pointed to the equal importance of considering larger and smaller units of inquiry (i.e., the children of poverty and individual student identities) in examining equity issues in mathematics education. If equity issues are examined from multiple perspectives, then we are more likely to achieve "fairness in dealing" with ALL students, regardless of gender, race, ethnicity, language or social class.

Just as it is important for students to develop an identity as *knowers and doers of mathematics*, it is equally important for mathematics educators to develop an identity as *knowers and doers of equity*. Too little research in mathematics education has focused squarely on equity issues, and even less has focused elsewhere while keeping equity concerns in mind. If progress is to be made, then it seems clear that the entire field, including its research, needs to become more self-con-

sciously interested in matters of equity. At this critical juncture in the history of mathematics education, research can contribute in fundamental ways to understanding and accomplishing the agenda of "mathematics for all." We are fortunate that Suzanne Damarin has provided us with a valuable set of resources for our work.

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