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Guest Editorial…

The Role of Mathematics Instruction in Building a Socially Just and Diverse Democracy

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As elementary school teachers, Deborah and Imani did not just teach academic subjects. They taught their pupils skills and knowledge to help develop them as individuals and as members of a collective. Subject matters offered important resources for these social goals: they and their students read literature in the voices of a wide range of people, about experiences both similar to and different from theirs. They studied other cultures and learned about work, life, and practice in a variety of societies and settings. And they learned that issues of voice, experience, culture, and setting were important threads in the tapestry of what it means to be human. The work they did with their pupils across these academic subjects was, of course, also aimed at developing the children's skills and knowledge, their capacity to interpret texts and artifacts, to reason in disciplined ways, and to solve problems within and beyond these domains.

Their young students were also resources for the goals toward which Deborah and Imani worked as teachers. From a variety of cultural backgrounds, and a wide range of communities, their students thought differently from one another, and they brought ideas and experiences to offer to the collective work in their classes. They were children — they made friends, argued and fought, and were generously caring. What they did, said, and felt comprised their classroom's working environment and offered a myriad of opportunities for learning. Over time, Deborah and Imani each learned to listen to and notice what the children brought and to use and mediate their differences.

All this was well and good — in reading, social studies, art, music, and even science. But mathematics seemed isolated from the rest. There seemed little to discuss, little opportunity to notice and use the diversity of their students. Deborah and Imani explained ideas and procedures, the students practiced, and they all reviewed. Although the two teachers thought the students were capable mathematically, the students did not think so. Some viewed themselves as "good at math," while others disparaged their own abilities. Deborah and Imani saw differences in accomplishment produced from their instruction, and they worried. They grew concerned about which students were coming to see themselves as "bad at math," and were quite sure that the source lay not with these students, but in their teaching.

Now, when the three of us discuss these teaching experiences, we understand a different landscape than Deborah and Imani knew to see then. We recognize that mathematics — and the ways in which teachers teach it — is a key resource for building a socially just and diverse democracy. While other school subjects, too, offer resources for democratic education and social justice, mathematics makes its own unique contributions to these goals. Instead of seeing mathematics as culturally neutral, politically irrelevant, and mainly a matter of innate ability, we see it as a critical lever for social and educational progress (Moses & Cobb Jr., 2001) if taught in ways that make

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use of its special resources. Three main points structure the perspective that we take in this essay.

First, in order to enable all students to be successful with mathematics, we see that some elements of "good teaching" of mathematics — listening closely to students' ideas, for example, or being sensitively careful at the interface between mathematical and everyday language — are especially important. They are important in order to recruit students into mathematics, as well as to help them succeed there. Consider the imperative to listen closely to students, and to be sensitive to the boundaries between mathematical and everyday language: Students who are working on mathematics in an English that they are just learning[1] express mathematical ideas in ways that seemed to us unusual or hard to understand at times; but when Deborah and Imani focused carefully, they heard significant mathematical insights they had previously missed, or misunderstood. The many varieties of English spoken in the classroom make it especially important to notice the ambiguities between technical and everyday uses of English: For example, what does it mean for a number to be "odd," or "big"? What is a "right" angle? What about "similar" figures, or "equivalent" fractions? Why are some numbers "rational" and others not, and still others "radicals?" Is there a synonym for "regular," and what is the distinctive technical meaning of a "group" — in elementary school or higher level math? All these are words used one way in everyday talk, and in other ways in mathematics. Mathematics often uses and specializes everyday language, sometimes metaphorically, rather than coining a separate technical vocabulary (Halliday, 1978), thus both enabling and complicating entry to its register (Pimm, 1987). Teachers also coin expressions to support students' learning, saying that a number "goes into" another, or that one "borrows" from the tens. So although listening closely and being careful about the differences between technical and everyday uses of mathematical language are important aspects of "good teaching," they demand emphasis in order to make mathematical success both common and expected.

Second, the disparities in mathematics achievement are tightly coupled with social class and race, and have not narrowed over the last decade despite a rhetoric of "mathematics for all." Some have come to suspect that some aspects of "good teaching" may unwittingly create, reproduce, or extend inequities among students, differences deeply rooted in the inequalities of our society (Ball, Hoover, Lewis, Bass, & Wall, 2003). Take an example: A glance at mathematics textbooks, even those newly designed or revised, reveals the settings for many mathematics problems to be most familiar to middle class white students. Plans for garden plots, mileage covered on family vacations, stereotypical images of "family," allowance plans — these and other "meaningful" and "real world" contexts may be more familiar and engaging to some students than to others. The effort to wade through an unfamiliar context in order to get to the mathematics can impede students' learning (Lubienski, 2002). The enthusiasm for "real world" problems, left unchecked, may disadvantage students for whom the chosen settings are not understood or valued. This is not to say that problems or contexts may not be useful to students, only that contexts are often social or cultural and depend for their usefulness on students' experiences. Attentive to this, some educators work to design contexts that are rooted in broader and more diverse experience and culture. They might use African designs as a site for studying geometric patterns, or urban street games as settings for using complex numerical strategies. Still, the difficulties that can arise from uneven familiarity with particular "contexts" require vigilance. We return below to the rich possibilities inherent in the use of cultural contexts.

Other practices of teaching thought to be "good" also deserve closer scrutiny — reluctance to "tell" students or to be explicit, for example. Letting students figure out crucial mathematical practices — how to compare representations, or how to build a mathematical argument — for themselves may well mean that only some students figure them out. This is not benign: Past evidence suggests that white or Asian middle class students, often male, tend to learn these implicitly, while many others do not (RAND Mathematics Study Panel, 2003). The contemporary enthusiasm for instructional approaches in which the teacher "facilitates" and refrains from being direct may be more congruent with some students' experiences and practices than others, thus inadvertently advantaging those students if participation in such discourse is not explicitly taught (Delpit, 1988; Heath, 19xx; Heath, 1983; Lubienski, 2002). And, moreover, explicit guidance for learning complex skills or ideas is essential if all students are to develop such capacities. Leaving the construction of these skills to chance can make student success susceptible to cultural differences in discursive norms.

Affirming students' accomplishments, rewarding success, and praise are all ways in which good teachers encourage and inspire students to work hard and to see themselves as mathematically capable (Boaler & NetLibrary Inc., 2000; Cohen, Lotan, Abram, Scarloss, & Schultz, 2002). But these also signal to students what it means to be "good at math." Unexamined, these messages may communicate a narrow perspective on what mathematical ability is, and thus assign competence unevenly and without attention to a full range of mathematical skill and practice, and their diverse forms of expression.

So far we have discussed what may underlie significant and persistent disparities in mathematics achievement, efficacy, and success. Although many important societal factors shape these disparities, instructional practices also matter. Instruction can take aim at pervasive inequality, or it can reinforce or even create it. Too often, unexamined, it may do the latter. Thus, learning to examine who and what is being valued and developed in math class is essential.

Still, our argument would be incomplete if we did not also consider what mathematics — and mathematics instruction — can contribute to education for democracy. As Malloy (2002) argues, mathematics education that is oriented to promote democratic goals can "provide students with an avenue through which they can learn substantial mathematics <u>and</u> can [develop into] productive and active citizens" (p. 21, emphasis added). Clearly, we need vigorous efforts to improve every student's access to and development of usable mathematical literacy, including the skills for everyday life, preparation for the increasing mathematical demands of even relatively non-technical workplaces, and for continued mathematical study. The need for collective commitment to this goal has never been greater. In addition, however, we claim that mathematics has a special role to play in educating young people for participation in a pluralistic democratic society. Making that possible depends on instruction that uses the special resources that mathematics holds for realizing these broader societal aims.

One way in which mathematics teaching can help to build the resources for a pluralistic society is through the development of tools for analysis and social change. Mathematics offers tools to examine and analyze critically the deep economic, political, and social inequalities in our society, for studying crucial societal problems, and for considering a host of issues that can be understood and critiqued using quantitative tools. For example, who voted in the last election and why? How does the Electoral College shape whose votes count most in a presidential election? How do our income and inheritance tax laws shape the distribution of wealth and access to fundamental resources, as well as what is valued? How does our system of school funding, for example through real estate taxes, shape the quality of education that different children in our country receive? Developing and using the mathematical skills that enable young people to engage in social analysis and improvement is one way in which mathematics can contribute to the development of a diverse democracy.

A second way in which mathematics teaching can play a role in education for democracy is as a setting for developing cultural knowledge and appreciation, important resources for constructive participation in a diverse society. Mathematics represents an ancient and remarkable set of cultural achievements and engagements. As such, the historical development of mathematical ideas and methods offers a medium for studying history and culture and their intersections in domains of human activity as diverse as architecture, art, music, science, and religion. Mathematics offers opportunities for young people to learn about their own cultural heritage and that of others. Such learning is crucial for developing the understanding and appreciation of diverse traditions, values, and contributions, and ways to notice, respond to, and use them. Such learning is also crucial for developing a sense of one's own cultural identity, and sense of self and membership, both for oneself and also as a participant in the broader cultural milieu.

But a third way that mathematics teaching can support the development of democratic goals — the one on which we focus here — is through the skills and norms embedded in mathematical practice itself. In other words, we argue that it is not just the content of mathematics and its tools that contributes to democratic goals, but the very nature of mathematical work. Mathematics instruction, we claim, can offer a special kind of shared experience with understanding, respecting, and using difference for productive collective work. How so? Consider that mathematics is centrally about problem solving, and about discovering and proving what is true. Alternative interpretations and representations of a problem can often serve to open a path to its solution; sometimes a novel metaphor, diagram, or context can crack a difficult part of a problem. At the same time, the use of difference is structured and supported by common disciplinary language, norms, and practices. Terms must be precisely defined and used in common ways. Disagreements are resolved not by shouting or by plurality, but by reasoned arguments whose construction can be taught and learned. Decisions such as whether 0 is even or odd, or how to interpret the meaning of $\frac{3}{4}$, whether $\frac{5}{5}$ is greater or less than $\frac{4}{4}$, or whether a solution to a particular problem is valid are subject to mathematical reasoning, not governed by desire or power. Moreover, mathematical reasoning is a practice to be learned, not an innate talent.

In these ways, mathematics instruction can deliberately help young people learn the value of others' perspectives and ideas, as well as how to engage in and reconcile disagreements. Mathematics instruction can be designed to help students learn that differences can be valuable in joint work, and that diversity in experience, language, and culture can enrich and strengthen collective capacity and effectiveness. Students can also learn that mathematics is not an arena in which differences are resolved by voting. Politics is an arena in which differences are managed in this way, but the study of literature or mathematics is not. In a democratic society, how disagreements are reconciled is crucial. But mathematics offers one set of experiences and norms for doing so, and other academic studies and experiences provide others. In literature, differences of interpretation need not be reconciled, in mathematics common consensus matters. In this way, mathematics contributes to young people's capacity for participation in a diverse society in which conflicts and are not only an inescapable part of life, but their resolution, in disciplined ways, is a major source of growing new knowledge and practice.

How might instruction be designed to serve both mathematical and democratic ends? One element would lie with the mathematical tasks selected. Tasks that serve to develop common skills, language, and practices offer ways that can help to build the common skills needed for class work on mathematics. Also useful are tasks that yield to alternative representations, so that students' understanding of the material is deepened through the different ways in which their classmates see the ideas. Although it is valuable to use mathematical tasks that profit from others' interpretations, such tasks should not, however, depend unfairly on unevenly distributed cultural experience or knowledge.

How mathematical tasks are used is crucial in determining whether or not their potential is realized in classrooms. If not carefully structured and guided, cognitively complex tasks can degrade to simple routine problems, and problems ripe with opportunity for reasoning and representation can become algorithmic (Stein, 1996). Similar vigilance is needed in order for tasks to serve as contexts for the development of democratic skills and dispositions. Such vigilance is centered on cultivating attention to and respect for others' mathematical ideas. Students would need to develop a consistent stance of civility with one another, a stance based on intellectual interest and respect, not mere social politeness or "niceness." This would require learning to listen carefully to others' ideas, and checking for understanding before disagreeing. Other skills, norms, and practices of collective mathematical work include giving credit to others' ideas — referring to ideas by their authors' names, for example — and critiquing ideas, not people, using the tools and practices of the discipline. Students would work to seek agreement on meanings and solutions, drawing on past shared experiences, definitions, ideas, and agreements about meaning, and they would use and contribute to one another's ideas in a collective effort to solve and understand the mathematics and the problems on which they are working. Important to our argument is that these skills and practices that are central to mathematical work are ones that can contribute to the cultivation of skills, habits, and dispositions for participation in a diverse democracy.

For mathematics instruction to contribute to the building of a socially just and diverse democracy will require more than care with curriculum and teaching. It will also require more than committed teachers, sensitive to and skillful in working toward these aims (Ladson-Billings, 2001). Accomplishing this would require significant change in teachers' education and professional development, no small task. But who these teachers are matters as well. We need a teaching force diverse in race, culture and ethnicity, and linguistic resources. The current teaching population is disproportionately white, female, and middle-class. The profession responsible for teaching our nation's children should include people of a wider range of cultural and experiential resources, both because young learners should have access to more diversity in the teachers from whom they learn (Irvine, 2003), and because the collective knowledge, practice, and norms of the profession would be improved if its members were more diverse. Responsible for helping prepare young people for life in society, teachers — and the mathematics instruction they offer — must collectively represent and take advantage of the multicultural nature of that society for individual and common good.

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[1] We include here those students whose mother language is another world language as well as those who speak one of many dialects of the English language (Adler, 2001; Baugh, 1999; Schleppegrell, 2002)