

## *Research Commentary*

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# **Toward a Framework for Research Linking Equitable Teaching With the Standards for Mathematical Practice**

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The *Common Core State Standards for Mathematics* (CCSSM) do not make any promises about the teaching practices that should be used to support students' enactment of the standards. Thus, equity gets framed as achievable through making the standards a goal for all students. We know from research on past reform efforts that standards without explicit (or companion) teaching practices, and teaching practices without explicit attention to equity, will inevitably result in the failure of the standards to achieve goals for students. This commentary provides a framework for future research that hypothesizes research-based equitable mathematics teaching practices in support of the CCSSM's Standards for Mathematical Practice, connecting research, policy, and practice in order to realize the equity potential of the CCSSM.

*Key words:* Equity; Diversity; Special needs; *Common Core State Standards for Mathematics*; Equitable teaching practices; Research issues

The *Common Core State Standards for Mathematics* (CCSSM) delineate the mathematical content all students should learn as well as eight Standards for Mathematical Practice (SMP) through which students should engage the mathematical content (National Governors Association [NGA] Center for Best Practices & Council of Chief State School Officers [CCSSO], 2010). In this commentary, we consider how the CCSSM, and thus the SMP, is positioned within a larger political context and how these political forces, combined with a lack of attention

to equity, will likely serve to reify existing inequities in mathematics learning. We focus on the enactment of the SMP as a way to make the CCSSM more equitable and offer a framework for future research linking equitable teaching with the SMP.

Although a few states that initially adopted the CCSSM have recently withdrawn and a few more states are reviewing their position (Bidwell, 2014), as of August 2015, 42 states have adopted the CCSSM (Ujifusa, 2015). Moreover, the National Council of Teachers of Mathematics (NCTM) has expressed support for the opportunity the CCSSM provides (<http://www.nctm.org/CCSSMposition/>) and produced resources aimed at supporting teachers' understanding of the CCSSM and the SMP (e.g., Koestler, Felton, Bieda, & Otten, 2013). These efforts point to the instantiation of educational policy through what may be the "most profound and widely distributed educational reform activity in recent history" (Koestler et al., 2013, p. v).

States opting out of the CCSSM and the ongoing debate about the policy, even as efforts are made to support its instantiation, reflect the fact that the CCSSM, like education more generally, is situated within broader sociopolitical structures and systems of privilege and oppression that influence how such policies are framed and taken up (Herbel-Eisenmann et al., 2013). Consideration of these broader sociopolitical structures is imperative, however, if the efforts of the CCSSM are to move beyond rhetoric toward change in students' learning of mathematics (Apple, 1992; Gates & Vistro-Yu, 2003).

The CCSSM is situated within broader social and political contexts and narratives. As such, it can be taken up and instituted in various ways. As outlined by Martin (2013, p. 318), a number of scholars (e.g., Apple, 1992, 2000; Atweh & Clarkson, 2001; Atweh et al. 2008; Ernest, 2009; Gutstein, 2008, 2009) have provided "compelling evidence" that mathematics education (which includes the CCSSM), when considered in relation to "market forces, market-driven goals, and increased globalization," is positioned as part of a larger, neoliberal narrative disconnected from the experiences and realities of students from nondominant communities (Eppley, 2015; Gutstein, 2010).

Neoliberalism supports the privatization of social goods and competitive markets as opposed to government provisions related to housing, health care, and education. The neoliberal agenda includes a focus on economic well-being and competitiveness in a global economy (Woodrow, 2003) and reflects a shift from education as a social concern to education as a market concern (Eppley, 2015). Neoliberalism focuses on cultivating citizens for gainful employment, as opposed to contributing to democratic life. As such, it contradicts a focus on students' communities, beliefs, and points of view and is grounded in racist ideologies (Lipman, 2012). Skovsmose and Valero (2002) argue that this reflects a "paradox of inclusion" because there is an inherent contradiction between the discourse of the neoliberal agenda—that of inclusion, well-being, and universal access tied to globalization of the economy—"and the deep disempowerment and exclusion that certain social sectors actually experience as a result of the practices associated to that discourse" (p. 384). The existence of this paradox directly challenges efforts

toward equity and justice. Policies reflecting a neoliberal agenda have been shown not to reduce inequity (and perhaps exacerbate inequity) (Diversity in Mathematics Education [DiME] Center for Learning and Teaching, 2007; Eppley, 2015; Gutstein, 2010; Skovsmose & Valero, 2002). As we outline next, the maintenance (or exacerbation) of inequity can occur through lack of attention to particular issues in the policy document itself as well as within the interpretation and subsequent implementation of the policy.

Further, the CCSSM lacks an explicit focus on race, class, and gender (Gutstein, 2010) despite the fact that “institutional and structural racism and political economy loom large in the experiences of urban youth, both within and outside the mathematics classroom” (Gutstein, 2010, p. 16). The absence of such focus or so-called “e(race)ing” suggests that the CCSSM, too, may reflect “white institutional space” (Martin, 2008, p. 387) that will continue to marginalize the lives and experiences of students from nondominant communities. As seen with California’s *Algebra for All* policy enactment, inattention to equity, race, and power leaves beliefs, conceptions, labels, and discourses about students from nondominant communities unchanged and suggests a need to “develop meaningful interventions, inside and outside of school, to empower marginalized students with mathematics so that they can change the conditions that contribute to inequities” (DiME Center for Learning and Teaching, 2007, p. 426).

Together, these arguments suggest that the CCSSM, with its implicit political and economic goals and its lack of explicit attention to race, gender, class, and so forth, is not framed to support equity. Further complicating this issue is the fact that the CCSSM does not provide, nor was it intended to provide, a description of specific pedagogical practices that can support student learning of its content goals and practices of engagement. That is, the connection between policy and practice is left undefined in the CCSSM. Past policy efforts suggest that a specific focus on mathematics teaching practices is essential for success. In the Chicago Public Schools’ College Preparatory Curriculum for All initiative, for example, although the policy ending remedial classes was implemented quickly and schools successfully eliminated low-level course work previously common among students labeled as “low ability,” virtually no change occurred in failure rates, test scores, or the likelihood of students entering college (Allensworth, Nomi, Montgomery, & Lee, 2009). These researchers concluded that a focus was needed on how content and curriculum were taught and, in particular, how to teach the content to different types of students. Similarly, Cuban (1990) argued that the reason reform happens “again, again, and again” is related to “the decoupling of instruction from administration and policymaking” (p. 11). One reason such policy may not have been successful is because systems of privilege and oppression operate in such a way that structures of schooling embedded in teaching practices were not affected (Apple, 1999). Rather, policies are taken up so as to “reinforce things as they are or to tinker with innovations that will leave untouched the regularities [and inequities] of schooling” (Cuban, 1990, p. 10).

Given the role that the CCSSM may play in perpetuating inequity, it is imperative to consider how this process may be co-opted to make its implementation more equitable. Research exists that can inform the identification of effective, equitable pedagogical practices that support students' learning of mathematics, which we refer to as *equitable mathematics teaching practices*. In this commentary, we suggest a framework for future research that hypothesizes research-based equitable mathematics teaching practices in support of the SMP. We argue that making a connection to both equitable mathematics teaching practices and the SMP can inform directions for related mathematics education research. We found that it made sense to align equitable mathematics teaching practices with the mathematical practices students would engage with; thus, we focus on the enactment of the SMP as a way to make the CCSSM more equitable. The SMP include eight "varieties of expertise that mathematics educators at all levels should seek to develop in their students" (NGA & CCSSO, 2010, p. 6). In identifying equitable mathematical teaching practices that map to the SMP, we started with those ideas outlined in the chapter on culture, race, and power in the *Second Handbook of Research on Mathematics Teaching and Learning* (DiME Center for Learning and Teaching, 2007) and added more from recent research. Importantly, we recognize that the list of practices we offer is necessarily an incomplete list.

As Cuban (1990) notes, "we can do better" (p. 12) than reform "again and again" (p. 11) by gathering data on the history of particular reforms in specific contexts (e.g., classrooms, schools, districts), as situated within broader structures influencing this work (e.g., school, structures, curricula), and by "examining carefully the alternative explanations offered" (p. 12). To do this, we suggest that mathematics education researchers conduct studies to help co-opt the CCSSM toward equity, including those that examine connections between equitable mathematics teaching practices and the SMP. Research aimed toward promoting equity requires the study of these reforms in specific contexts, such as classrooms, schools, and districts, in order to understand how such reforms occur within inequitable structures and how they do and do not support each student's learning of mathematics. We align equitable mathematics teaching practices with the SMP, connecting goals for students with research on effective pedagogy for students from nondominant communities. Using this as a framework, we call for specific research that will allow the field "to adopt a more informed stance when dealing with the contentious issues of policy and practice" (Kilpatrick, 2007, p. 107).

### **A Framework for Linking Equitable Mathematics Teaching Practices to the SMP**

In an effort to provide some guidelines for thinking about how teachers might provide equitable opportunities for students as they engage in the SMP, we identified what we considered to be some of the core equitable mathematics teaching practices and the research that supports those practices. In Table 1, we articulate the equitable mathematics teaching practices that we have identified and provide selected examples of how each practice might be enacted. We recognize that this

Table 1  
*Equitable Mathematics Teaching Practices*

Equitable practice	Examples of the practice
1. Draw on students' funds of knowledge	<ul style="list-style-type: none"> <li>• Build on community and cultural knowledge and practices (Civil, 2007)</li> <li>• Recognize students' cultural and linguistic resources (Gay, 2002; Ladson-Billings, 1995)</li> <li>• Have robust knowledge of students, validate shared ideas and experiences, and connect instruction to students' experiences and interests (Aguirre et al., 2013; Bartell, 2011; Hedges, Cullen, &amp; Jordan, 2011; Wager, 2012)</li> </ul>
2. Establish classroom norms for participation	<ul style="list-style-type: none"> <li>• Recognize that student voice has implications for power and authority and builds agency (Cobb &amp; Hodge, 2007; Turner, Dominguez, Maldonado, &amp; Empson, 2013)</li> <li>• Set up and guide discussions so that students from nondominant backgrounds develop strong mathematical identities (Hodge, 2006)</li> <li>• Connect pedagogical practices to student participation (Boaler &amp; Greeno, 2000; Wager, 2014)</li> <li>• Question whose participation norms are valorized (Planas &amp; Gorgorió, 2004)</li> </ul>
3. Position students as capable	<ul style="list-style-type: none"> <li>• Construct social structures that enable students to "develop strategies that help maintain certain positions and reduce others" (Planas &amp; Civil, 2010, p. 145)</li> <li>• Challenge and counteract societal stereotypes and inequities to which students and communities are subjected (Bartell, 2011; Gay, 2002; Ladson-Billings, 1995)</li> <li>• Attend to how the curriculum may influence perceptions of students (Atweh, Bleicher, &amp; Cooper, 1998)</li> <li>• Share power in the classroom by allowing students to provide meaningful input in making decisions about classroom practices, curriculum, and assessment (Cornelius &amp; Herrenkohl, 2004; Sheets, 2005)</li> </ul>
4. Monitor how students position each other	<ul style="list-style-type: none"> <li>• Assign competence to support students' repositioning of one another (Cohen, Lotan, Scarloss, &amp; Arellano, 1999; Featherstone et al., 2011)</li> <li>• Attend to reification of existing status structures so as to reposition some students with their peers (Forman &amp; Ansell, 2002)</li> <li>• Position students to use one another as mathematical resources (Dunleavy, 2015)</li> </ul>
5. Attend explicitly to race and culture	<ul style="list-style-type: none"> <li>• Make connections to students' mathematical, racial, and cultural identities (Battey, 2013; Martin, 2007)</li> <li>• Recognize that certain groups have been positioned as anti-intellectual (Martin, 2009; Steele, 2003)</li> </ul>

Table 1 (continued)  
*Equitable Mathematics Teaching Practices*

Equitable practice	Examples of the practice
6. Recognize multiple forms of discourse and language as a resource	<ul style="list-style-type: none"> <li>• Facilitate respect among students by cultivating culturally responsive relationships among students and validating possible differences in their language practices (Moschkovich, 2013)</li> <li>• Coconstruct resources with students in moment-to-moment interactions around mathematics (Dominguez, 2014)</li> <li>• Consider linguistic choices and acknowledge home language as a valid language of mathematics (Meaney, 2005; Setati, 2005)</li> <li>• Bridge language practices through affirming students' home languages, modeling code switching, and fostering interactional patterns familiar to students (Brenner, 1998; Howard, 2001; Lee, 1995)</li> </ul>
7. Press for academic success	<ul style="list-style-type: none"> <li>• Assess student learning, build on student strengths, explicitly communicate expectations for students, and communicate the teachers' responsibility in student success (Morrison, Robbins, &amp; Rose, 2008)</li> <li>• Have high academic expectations while maintaining students' cultural and psychological well-being rather than accept deficit views about students' intellectual potential (Fine, 1986; Fordham, 1988)</li> </ul>
8. Attend to students' mathematical thinking	<ul style="list-style-type: none"> <li>• Recognize, understand, and build from children's understanding of mathematics (Carpenter, Fennema, Franke, Levi, &amp; Empson, 1999)</li> <li>• Respond to developmental needs so as not to expect a student to do mathematics they are not developmentally ready for (Jackson, 2009)</li> </ul>
9. Support development of a sociopolitical disposition	<ul style="list-style-type: none"> <li>• Incorporate critical texts, discuss controversial topics, serve the community, and allow social issues to drive instruction (Hickling-Hudson &amp; Ahlquist, 2003; Hyland, 2005; Tate, 1995)</li> <li>• Provide opportunities to explore sociopolitical topics using mathematics (Frankenstein, 2012; Gates &amp; Jorgensen, 2009)</li> <li>• Engage students in conversation about real-world problems and how mathematics can be used to examine them (Gutstein, 2006; Skovsmose, 1994)</li> </ul>

is not a complete review of the literature, but we want to provide a starting point to engage the field in a conversation about the practices and to encourage research on these ideas as they are connected to the SMP. We also acknowledge that the constraints of a research commentary necessarily limit our ability to address other aspects that have been found to inform equitable teaching practices; some of those not incorporated in our discussion include teacher positionality (e.g., Hand, 2012; Wager, 2014), identity (Esmonde, 2009), and teacher beliefs (e.g., Philipp, 2007).

After identifying the equitable mathematics teaching practices, we identified examples of how each practice might be enacted in supporting students to develop each of the SMP. Imagine, for example, a table in which the equitable mathematics teaching practices from Table 1 are listed in column 1 and the SMP are listed in columns 2 through 9, such that sample practices at the intersection of each equitable mathematics teaching practice with each SMP are delineated (see Figure 1). We do not have the space here to elaborate practices for the intersections represented by each cell in the table; however, in an effort to illustrate the possibilities of such a framework, we provide examples of practices that would populate two cells in such a table.

**Drawing on Students’ Funds of Knowledge as They Make Sense of Problems and Persevere in Solving Them**

Consider the cell (A in Figure 1) marking the intersection between Equitable Mathematics Teaching Practice 1 (draw on students’ funds of knowledge) and SMP1 (make sense of problems and persevere in solving them). To support students’ development of this SMP that includes students’ making sense of problems by “explaining to themselves the meaning of a problem and looking for entry points to its solution” as well as in “analyz[ing] givens, constraints, relationships, and goals” and in “continually ask[ing] themselves ‘Does this make sense?’” (NGA & CCSSO, 2010, p. 6), teachers could explicitly construct problems (or adapt problem contexts) connected to students’ experiences or community or

Equitable Mathematics Teaching Practice	Standards for Mathematical Practice							
	1 make sense	2 reason abstractly	3 construct arguments	4 model	5 use tools	6 precision	7 structure	8 reasoning
1 Funds of Knowledge	A							
2 Participation norms								
3 Position as capable								
4 Position each other								
5 Culture & race								
6 Discourse as resource								
7 Academic success								
8 Mathematical thinking								
9 Social Justice				B				

Develop problems that draw on students’ funds of knowledge and require students to make sense (e.g. carnival problem – how many combinations of tickets to rides and for food can students come up with).

Support students’ socio-political disposition as they model with mathematics (e.g. develop models to predict future minimum wage).

Figure 1. Framework for the intersection of equitable mathematics teaching practices and the SMP.

family practices. For example, Turner et al. (2014) described lessons prospective teachers created that elicited and connected to students' cultural funds of knowledge across multiple components of a mathematics lesson. In one lesson, prospective teachers designed a series of mathematics tasks about different ways to spend 25 tickets at a carnival on rides or food. Choosing how to use tickets at a local carnival was known to be an experience most of the students had engaged in, and the task was designed to support students in understanding that a number can be composed of a variety of addends. In this example, students made sense of the situation by considering things like their favorite rides and the fact that they did not have enough tickets to go on every ride and to eat all their favorite foods. Each student came up with different combinations of rides and food that met their own interests to try to maximize use of all tickets. The prospective teachers noted that students engaged in the task in multiple ways (finding different entry points) and showed increased engagement in comparison to tasks they had used previously. Research demonstrates that students benefit from instruction that draws upon their cultural and community-based knowledge (González, Moll, & Amanti, 2005; Ladson-Billings, 1995). Moreover, students are more likely to persevere in a problem that is of interest to them (Renninger, Ewen, & Lasher, 2002) and to make sense of a problem and identify an entry point if a task is introduced in a way that includes discussion of key contextual features (Jackson, Garrison, Wilson, Gibbons, & Shahan, 2013).

### **Supporting Students' Sociopolitical Disposition as They Model With Mathematics**

Consider the cell (B in Figure 1) marking the intersection between Equitable Mathematics Teaching Practice 9 (social justice) and SMP4 (model with mathematics). At this intersection, students would work on ill-defined problems from real-world contexts that require them to struggle to use mathematics to understand the problem (Koestler et al., 2013) in order to understand and change their world (Gutstein, 2006). For example, Powell (2012) described a unit she developed in which her students modeled with mathematics to predict the future minimum wage based on a given data set. In this unit, students were able to build on their own understanding and experience with various functions (quadratic, linear, piece-wise) to model real-world, relevant data to make predictions that would have an impact on their lives. This activity led to important discussions about decisions students made in choosing the subset of data and function that they used as well as the implications of a minimum versus living wage. Although the idea of supporting students to model with mathematics using a social justice context is gaining traction as a way to support students' engagement in both practices (Cirillo, Bartell, & Wager, 2016; Felton, Anhalt, & Cortez, 2015), we recognize that this work is not without tensions. As both Bartell (2013) and Enyedy and Mukhopadhyay (2007) have found, teachers who bring in emotionally charged topics must be prepared to facilitate and respond to students' struggles with the subject.



### Call for Future Research

As articulated in the introduction, our call for research is based on our concerns that enacting the CCSSM without explicit attention to equity will only serve to reify existing inequities. We have three questions to pose to the mathematics education community that will support connections of equitable mathematics teaching practices to the SMP:

1. How can we theorize equitable mathematics teaching practices that support student engagement in the SMP?
2. In what ways are the teaching practices that attempt to align with the CCSSM supporting equitable learning opportunities?
3. What kinds of studies might support teachers to engage in equitable mathematics teaching practices that connect to the SMP?

For the first question, our framework offers a starting point with references in Table 1 to several scholars in the field who have been studying equitable mathematics teaching practices. Beyond a review of the literature, we see a need for the field to theorize how these studies of equity mathematics research are interwoven and can be connected specifically to the SMP. In our first example above, teachers who draw on students' funds of knowledge may be supporting the development of making sense of problems (SMP1) while also supporting students in making connections between problems in school mathematics and their everyday experiences. In what other ways does this equitable mathematics teaching practice support students to develop other SMP?

With respect to the second question, several scholars are already studying the impact of the CCSSM on student learning, although few of these studies are connected to the ideas of opportunity to learn (see Esmonde, 2009, for an exception) and access. In a search using the terms *common core*, *mathematics*, and *learning*, we found 69 relevant peer-reviewed articles available through ERIC's database. A large number (39%) of these articles appeared in NCTM's three practitioner journals, and claims in over half of the articles (52%) are grounded in theory or analyses of curricula or tasks rather than in empirical findings. Only 25% of the articles explicitly addressed the impact of the CCSSM on opportunities for all students to learn. In particular, authors focused on students who qualify for special education services (learning disabilities, emotional behavioral disabilities, etc.; 13% of total articles), English language learners (6% of total articles), and students from low socioeconomic status backgrounds (4% of total articles). With few exceptions, we found that learning as measured by many of those studies does not necessarily consider the opportunities for all students to learn. As such, we suggest that the field needs to study classrooms to identify those teachers using the CCSSM and also enacting equitable mathematics teaching practices. These studies will shed light on how equitable practices are improving students' opportunities to learn.

For the third question, we suggest that scholars whose research is centered in the SMP need to extend that work to also consider whether equity is attained in those classrooms. We also suggest that scholars whose research is centered in equitable mathematics teaching practices need to extend that work to also consider how those practices support students in their engagement with the SMP. Much as Koestler, Felton, Bieda, and Otten (2013) drew connections between the SMP and the NCTM process standards, we envision that for each of the SMP, there are activities/problems/practices that connect to each of the equitable mathematics teaching practices (i.e., examples that would populate each cell in the table). Our goal is to suggest to the field that this framework can be used for future research by studying the connections in each of the cells, columns, or rows. This framework would provide an opportunity for scholars across the mathematics education field to engage with the ideas of equitable mathematics teaching practices that support students to engage in the SMP no matter where they position their research. For example, scholars who study mathematical modeling might design a study around an individual cell in the table, such as the intersection of modeling and social justice as discussed above, or they might explore how each equitable mathematics teaching practice might be evidenced in their study of mathematical modeling. We also believe this framework provides an excellent opportunity for scholars across areas of mathematics education to collaborate on studies at the intersections of equitable mathematics teaching practices and the SMP.

### Conclusion

In this commentary, we are (a) calling for research that attends to a critical topic connecting policy, research, and practice; (b) providing explicit questions we believe the field needs to address; and (c) offering a starting point (our framework) to identify studies that align with a wide range of research agendas while still addressing a central theme. By attending to these ideas, it is our hope that the field, as a community, can connect existing (and new) research to policy in order to support equitable practices that provide all students with the opportunity to learn mathematics. Without this, we see the CCSSM as yet another reform idea that, in the end, reproduces past inequities.

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