In this paper, I focus on what it means to view equity in mathematics education from an asset perspective. Examples are provided to elucidate the importance of eliciting students’ mathematical ideas and constructing instruction based on these ideas. I will also provide an example that demonstrates the importance of students who have historically been marginalized in mathematics education in the United States (U.S.), students of color and low-income students, experiencing mathematical success.

The achievement gap in mathematics has become a taken-for-granted aspect of the educational landscape in the U.S. (Gutiérrez, 2008). However, instead of accepting the achievement gap as innate and immutable to change, it can be viewed as an “opportunity gap” (Flores, 2008). From this perspective, the access that students have to opportunities to learn mathematics is at the root of differences in student achievement in mathematics. Student access to a challenging standards-based mathematics education is influenced by race, ethnicity, socioeconomic status (SES), and English language proficiency (Gutiérrez, 2008; Kitchen, DePree, Celedón-Pattichis, & Brinkerhoff, 2007; Martin, 2013). For instance, schools that enroll large numbers of African American students often have disproportionately high numbers of remedial classes in mathematics in

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1 Standards-based reforms in mathematics refer to mathematics curriculum and instruction that promote the development of student reasoning through problem solving and discourse (see for example, NCTM, 1989; 2000; NSF, 1996).
which instruction is focused on rote-learning and strategies that are intended to help students be successful on standardized tests (Davis & Martin, 2008; Lattimore, 2005).

Brynes and Miller (2007) found that SES has direct effects on mathematics achievement because students from higher SES homes have access to better-trained teachers, among other things, and tend to perform at higher levels than students from lower SES backgrounds. Moreover, SES has indirect effects on both the opportunities students have to enroll in advanced mathematics classes in high school (i.e., students in lower SES communities tend to have less access to advanced mathematics courses) and on their propensity to take advantage of learning opportunities in mathematics (Brynes & Miller, 2007). Hogrebe and Tate (2012) found that algebra performance is influenced by where students live; the SES of local communities is significantly related to students’ performance in algebra (i.e., the higher the SES of the community, the higher the algebra performance). These are just a few examples of how students in low-income communities do not have the same opportunities as their counterparts from higher SES communities to engage in standards-based mathematics curriculum and instruction (Kitchen, 2003; Martin, 2013).

In addition to poverty and SES, student access to a challenging standards-based mathematics education is influenced by race, ethnicity, and English language proficiency (DiME, 2007; Gutiérrez, 2008; Martin, 2013). A role that mathematics has played historically is to sort and stratify students by race, ethnicity, and gender (DiME, 2007; Gerdes, 1988). Specifically, white and Asian middle class and upper-middle class students have been privileged to have greater access to challenging mathematics curriculum and instruction (DiME, 2007; Tate, 1995). Schools that enroll large numbers
of African American students often have disproportionately high numbers of remedial classes in mathematics in which instruction is focused on rote-learning and strategies that are intended to help students be successful on standardized tests (Davis & Martin, 2008; Lattimore, 2005). In response to NCLB (2001) and the demands to increase test scores, Davis and Martin (2008) argue that the preponderance of skills based instruction “[negatively] shape the lives of poor African American students in more significant ways than middle-class or affluent students” (p. 18).

In schools that serve large numbers of immigrant Latino/a students who speak with an accent, use English words incorrectly or speak in Spanish as a means to express themselves, educators, peers and community members may assume students lack the capacity to perform well in mathematics (Moll & Ruiz, 2002; Téllez, Moschkovich, & Civil, 2011). “Deficit perspectives” such as these attribute lower levels of academic achievement to specific ethnic/racial groups based upon characteristics such as lack of fluency in English, life experiences that do not parallel those of the dominant society, or low family income (Gutiérrez, 2008; Spielman, & Mistele, 2013).

Instead of looking at students and their communities through a deficit lens, students can be viewed as having funds of knowledge such as knowing one language and learning another, having experiences that are richly grounded in their culture, and having extensive mathematics experiences in their daily lives (Moll & Ruiz, 2002). If educators build on the attributes students possess and treat them as mathematically competent, there is greater potential for increased academic success and an enhanced mathematical identity (Kitchen, Burr, & Castellón, 2010; Turner, Celedón-Pattichis, & Marshall, 2008). In the first vignette that followings, Marisol demonstrates that she has mathematical ideas
that the instructor can use to help her arrive at a solution to the problem presented.

Throughout, the instructor her ideas are taken seriously by the instructor, rather than dismissed as not correct.

Vignette #1: Building on ELL Students’ Mathematical Ideas in Instruction

In the following vignette, a description is provided of how Marisol solved the following problem:

Veronica has \( \frac{5}{4} \) pounds of grapes. She gave \( \frac{2}{3} \) pounds to Marisol. How many pounds of grapes does Veronica have left?

Initially, Marisol subtracted the whole numbers; she then converted the fractional portion of the mixed numbers \( \frac{1}{4} \) and \( \frac{2}{3} \) to \( \frac{3}{12} \) and \( \frac{8}{12} \), respectively. She indicated that she was not sure how to compute \( \frac{3}{12} - \frac{8}{12} \), because she did not believe it to be possible to take eight from three. So, Marisol decided to subtract three from eight and got six due to a computational error. She then inserted a negative sign in front of the number, arriving at \( -\frac{6}{12} \).

The interviewer proceeded by asked Marisol how she could combine three and the fractional part of the solution, \( -\frac{6}{12} \). She indicated that the six (the numerator of the
fraction) could borrow something from the three. To represent the three wholes, she drew three rectangles and divided each one into 12 pieces. She then drew an extra rectangle to represent \( \frac{6}{12} \).

Marisol spent several minutes thinking about what to do next, and decided to leave the answer as \( 3 \frac{-6}{12} \). She stated, “I do not like negatives.”

During the next stage of the interview, Marisol explained the same procedure to solve the problem just described, but realized that she made a mistake when subtracting the fractions and decided to change her solution to \( 3 \frac{-5}{12} \). The interviewer questioned her about the meaning of the negative fraction within the mixed number and asked if the actual solution is less than or greater than three. Marisol was able to recognize that this value would be less than three. In the end, Marisol did not combine the whole number and the negative fraction.

Though Marisol did not arrive at what may be considered a legitimate solution, she clearly demonstrated correct mathematical thinking. Working in a learning environment in which her ideas were actively sought out and respected, Marisol created a strategy to solve the problem. This strategy appeared to be of her own making, that is, she was not applying a learned algorithm to derive a solution. Precisely because she felt encouraged to explore her ideas and was treated as mathematically competent, Marisol took the chance of deriving a solution in her own way. The learning environment that had been created for Marisol paved the way for her to experiment and pursue a problem.
solving strategy that made sense to her. Without a doubt, she would have been penalized for arriving at a solution of $3 \frac{-6}{12}$ on a paper/pencil examination, and would mostly likely have been penalized for the solution $3 \frac{-5}{12}$.

In this vignette, Marisol is treated as mathematically competent (Kitchen, Burr, & Castellón, 2010; Turner, Celedón-Pattichis, & Marshall, 2008), and she demonstrates that she has sound mathematical ideas. As Marisol’s teacher, it was clear to me from this example that she needed help understanding negative numbers. It was also important to assist her to understand that $3 \frac{-5}{12}$ can also be represented as $\frac{3}{1} - \frac{5}{12}$. She demonstrated a strategy that made sense to her as a means to derive a solution. As her instructor, it was important to me to both validate this strategy and look for opportunities for Marisol to show and explain this strategy to her peers as a valid way to solve problems involving the addition and subtraction of mixed numbers. Through validating Marisol’s ideas, I could help her develop a positive sense of herself in mathematics, that is, enhance her mathematical identity (Boaler, 2002; Cobb, Gresalfi, & Hodge, 2009; Martin, 2000; Nasir & Hand, 2008). In this next vignette, some examples are provided to demonstrate the importance of students experiencing mathematical success (Kitchen, 2015).
Vignette #2: The Importance of Students Experiencing Mathematical Success

For the duration of the 2007-08 school year, I taught a 6th grade class using the Connected Mathematics Program 2 (CMP) in Albuquerque, New Mexico. I had 17 students in the class, 13 girls and 4 boys. At the time, all of the students would have qualified for Free Reduced Lunch. The class composition was also highly diverse; 14 of the students were of Mexican descent and 12 were English language learners (ELLs). Two of the students are twin sisters and African-American. For the duration of the year, I maintained a journal of my experiences. In this vignette, I share what I learned about the importance of students, particularly low-income students and racial/ethnic minority students\(^2\), having the time and support needed to learn challenging mathematical ideas.

A particularly important revelation for me as a 6th grade CMP teacher concerned the fragility of many of my students’ “math egos.” It should not be underestimated how tentative middle school students may feel about themselves and their mathematical abilities. It is important to note that many of my students who exhibited among the most fragile math egos were my “struggling learners,” these students had not experienced much success in mathematics. Importantly, many of these students are students of color. I can imagine many students with fragile math egos giving up quickly in CMP classrooms if they do not have regular access to teachers and tutors who can help them make sense of mathematical ideas.

What can CMP teachers do to help students develop a positive mathematical identity? What I learned is that students, particularly students with fragile math egos,

\(^2\) I use “low-income students” as synonymous with students who are classified as living in poverty in the United States (U.S. Census, 2010). “Students of color” is used as synonymous with “ethnic and racial minority students” and “culturally and linguistically diverse students.”
need to continually experience success in mathematics. Success for some students may be as simple as finding the product of two single digit numbers. This is especially the case with learners who have not experienced much prior success in their mathematics classes. To support student success and even celebrate them, I looked for occasions to emphasize my 6th graders’ brilliance (Martin & Leonard, 2013). For example, during one unit, I made a point to continually call on Britney, one of the African American twins, because she was doing a great job of talking the class through how to multiply two 2-digit numbers. She became our class expert on 2-digit multiplication; something that should took pride in as the year progress. During another lesson, I continually called on Janie, an ELL who was among my weakest students in mathematics, but who was doing a nice job of filling in the blanks in the multiplying decimal activities (e.g., 2.4 x 10 = 24.0, therefore .24 x 10 = __). My goal in both cases was to purposely highlight the accomplishments of Britney and Janie, to position them as mathematically capable (Kitchen, Burr, & Castellón, 2010; Turner, Celedón-Pattichis, & Marshall, 2008), and to support their sense of themselves as able learners of mathematics. It is also important to note that both students are female students of color. In my effort to support the development of positive student mathematical identity, I believe it is vital to intentionally notice and validate the mathematical thinking and accomplishments of historically marginalized student groups in mathematics (Martin, 2000).

I also learned that reinforcing my students’ mathematical learning through practice helped support their emerging positive mathematics identities. As students were learning important mathematical concepts, they needed time to reflect upon what they had learned through exploration and to solidify what they had learned through practice.
For example, as described earlier, we engaged in excellent investigations that helped students make sense of how to find decimal products. After participating in some nice explorations such as $24 \times 10 = 240$, find $2.4 \times 10$, students needed time to find the products of other decimal numbers to solidify their understanding and continue to gain confidence in their newfound knowledge. This proved particularly important for students with fragile math egos.

**Final Remarks**

Supporting students to have rich opportunities to engage in, have success with, and potentially even relish learning challenging mathematical content is demanding. A tragic educational legacy in the U.S. is that many students, particularly low-income students of color, have had limited access to opportunities to engage in a challenging standards-based mathematics education (Kitchen, et al., 2007; Martin, 2013). In the vignette provided about Marisol and in my work to engage 6th graders, I learned about the importance of validating the mathematical ideas that students bring to the classroom and supporting students to have success with mathematics. My students also needed to just practice some of the complex ideas they had devoted significant effort to make sense of,
and success through practice helped support their developing a positive sense of themselves and what they are capable of doing in mathematics. To be clear, I am not advocating here for practice that equates with the sort of low-level mathematics education that has historically been found in schools that primarily serve low-income, students of color in which the memorization of math facts, algorithms, vocabulary and procedures are the focal point of instruction, rather than teaching students through the use of complex, challenging problems (Davis & Martin, 2008; Kitchen, et al., 2007; Lattimore, 2005). My point is simply that practice can play a role when a standards-based mathematics program is in use to support students’ burgeoning mathematical identities. Specifically, I found practice helped my students, particularly those who had previously experienced little success in mathematics, gain confidence in their abilities and begin to believe that they could in fact do and learn some mathematics.

Interestingly, experts on Response to Intervention (RtI), a program that is being used nationally to provide early interventions for students who experience learning difficulties (Fuchs, Vaughn, & Fuchs, 2008) recognize that mathematical success leads to more success for struggling students (Formative Assessment Working Meeting, 2014). I believe that we need to focus more in the mathematics education community on providing opportunities for students, particularly students who have not had many uplifting experiences in mathematics, to have more mathematical successes. This is especially important if a teacher is using a challenging, standards-based mathematics program in a classroom with students who may not possess positive identities about themselves in mathematics.
References


