Opening Classroom Spaces for the Mathematical Success of African American and Latino/a Students

Rebecca Neal • Arizona State University
Dan Battey • Rutgers University

INTRODUCTION

A number of studies have found that mathematics instruction for African American and Latino/a students with low socioeconomic status often emphasizes disconnected concepts, mathematics vocabulary out of context, following steps, and controlling for socioeconomic status, African American and Latino/a students embody by acknowledging the importance of attending to students' ways of being and by opening spaces for varied styles of teaching and learning (Gay, 2002; 2010; Ladson-Billings, 1992, 1995, 2009; Howard, 2001a, 2003; Lee, 2003; Lee, Spencer, & Harpalani, 2003). This type of approach has been called culturally responsive or relevant teaching and describes a pedagogy in which teachers are intentional in acknowledging (or valuing) students' cultural backgrounds as an asset. When teachers value the prior experiences of students, students feel connected to their teacher and feel cared for within the classroom (Howard, 2001b). In that same vein, enriched learning spaces are created in classrooms when teacher practices allow for multiple forms of participation.

In opening such spaces, teachers make room for students to bring outside school experiences, culture, and non-standard discourse practices across the classroom boundary. To create spaces that open multiple ways of being within mathematics classrooms, Bartell (2011) suggests that teachers must demonstrate care by developing relationships with students and knowing them well. This means a dual relationship must be developed where teachers share of their own personal lives as well as participate in and value their students' lives. When teachers both share of themselves and value students experiences, it shows that teachers have a willingness to develop classroom environments that students view as supportive, nurturing, and caring (Bartell, 2011; Howard, 2001b). In fact, students' perception of teachers as caring is seen as a way for teachers to develop effective relationships with students, including African American and Latino/a students (Good & Brophy, 2000; Howard, 2001a; Noddings, 1992).

Developing caring relationships can be embedded in the teaching of mathematics through teachers being intentional in reducing issues of power and status, positively acknowledging student contributions, framing students as mathematically capable, and attending to language and culture (Battey, 2013; Hand, 2012). In these ways, a more culturally relevant mathematics instruction can be provided for all learners, especially for students from linguistically and culturally marginalized backgrounds. Without a reciprocal caring perspective between teachers and students, teachers could unknowingly create contentious learning environments for students (Hackenberg, 2005; 2010;
Positive Relational Interactions that Promote Successful Teaching in Mathematics

In general, classroom mechanisms are not well understood other than that poor quality instruction can affect outcomes for African American, Latino/a and low income students (Lubinski, 2002). One mechanism that needs to be better understood is the association between traditional dimensions of mathematics instruction and relational interactions among teachers and African American and Latino/a students. As it stands, moment-to-moment episodes of interactions between African American and Latino/a students and teachers within mathematics classrooms have not been well researched (Battey, 2013). We define relational interactions as moment-to-moment communicative actions between teachers and students, occurring through verbal and nonverbal behavior, which convey meaning and mediate student learning beyond the mathematics or instructional techniques (Battey, 2013). In particular, understanding positive relational interactions that promote the mathematical success of African American and Latino/a students is needed. Presently, within mathematics classrooms, little is known about the communicative interactions between teachers and students that convey meaning about engaging in mathematics.

Research on teacher-student relationships has found that many teachers misinterpret their relationships with low income African American and Latino/a students and lack an understanding of what students consider to be meaningful relationships with teachers (Murphy, Waas, & Murray, 2008). For instance, Saft and Pianta (2001) noted that teachers generally rated their relationship with African American students higher in conflict, Murray and colleagues (2008) found that, unlike teachers’ ratings of white students, teacher ratings of their closeness or conflict with African American students did not relate to the students’ ratings of liking school. The authors raised the possibility that teachers interpreted compliance and behaving as closeness and liking school for African American students, but that these behaviors did not mean the same thing for African American students themselves. In prior work, the second author documented a teacher who had more negative than positive relational interactions with her mathematics students (Battey, 2013). The teacher’s negative interactions devalued students’ home language practices, ignored student contributions, and framed student behavior as problematic. This occurred despite quality mathematics instruction in terms of eliciting student explanations, having students share strategies, and focusing on critical mathematical concepts. This is consistent with Stiff and Harvey’s (1988) claim that teachers of African American students often hold negative views of their students leading to inadequate academic instruction. These impoverished views and relationships with African American students negate the fact that they enter into classrooms with a rich set of personal resources (Howard, 2001b, 2003).

In contrast, culturally relevant mathematics instruction positively acknowledges student contributions, reframes deficit stereotypes about mathematics abilities, and attends to language and culture, opening multiple ways of being for students to engage both the teacher and the mathematics (Brenner, 1998; Ladson-Billings, 2002; Lipka & Adams, 2002; Nelson-Florner & Fein, 1995). It is important to say that teachers cannot practice these dimensions in isolation from one another and that caring relationships involve reciprocity between teachers and students (Battey, 2011). In order for students to perceive a teacher as caring, the teacher’s behavior and relational interactions with students must demonstrate that they value students’ mathematical contributions and cultural backgrounds. Thus, mathematical caring relationships between teachers and students must involve a communication of caring that result in students feeling cared for (Hackenberg, 2005, 2010; Noddings, 2001, 2002). This paper showcases the positive ways in which two teachers acknowledged student contributions, framed students’ abilities, and accessed culture and language in one urban school.

Specifically, both teachers engaged in high quality math instruction, but also developed caring relationships with students. Through our work, instead of teachers viewing cultural differences that can exist between school and a student’s background as a deficit, we highlight examples of teachers engaging in positive relational interactions during quality mathematics instruction with African American and Latino/a students in ways consistent with culturally relevant pedagogy by opening spaces for multiple ways of being in the mathematics classroom.

METHOD

A Mathematics Classroom as Context for Learning that Goes Beyond the Curriculum

When conceptualizing quality mathematics instruction, instructional practices and teacher knowledge are elements commonly cited (Wilson, Cooney, & Stinson, 2005). However, to focus on these two elements exclusively ignores relational, cultural and racial aspects of classrooms (Battey, 2013). For those reasons, we used Battey’s (2013) Relational Interactional Framework as a lens to better understand teacher-student interactions as an aspect of mathematics instructional quality.

This framework was also chosen because it specifically takes into consideration teacher-student interactions and provides a viewing frame that allows the researcher to deconstruct episodes of relational interactions into micro communicative acts for the purposes of observing exchanges with students, and in this case, African American and Latino/a students during mathematics instruction.

In this study, we examined the verbal and nonverbal communicative action between teachers and students for the purposes of determining its influence on quality mathematics instruction. In previous research during the development of this framework (see Battey, 2013), relational interactions were defined as teacher-student interaction that went beyond mathematics and five different dimensions of relational interactions between students and teachers and their influence to quality mathematics instruction were identified: (a) addressing behavior, (b) framing mathematics ability, (c) acknowledging student contributions, (d) attending to culture and language, and (e) setting the emotional tone of the classroom.

The aforementioned dimensions were also used in this study because these dimensions are particularly helpful in allowing teachers to develop an understanding of students that goes beyond the curriculum, by considering relational interactions when conceptualizing quality mathematics instruction.

The forms of emphasis, such as word choice and facial expression, were determined by multiple coders from different cultural backgrounds. This occurred because it was important to have coders with multiple interpretations involved in the analysis. This coding process also allowed the study to adjust to teachers because some talk louder than others or use more hand gestures and so on. Therefore, emphases could be coded with respect to the norms of individual teachers. Instances of relational interactions were identified as teacher-student communicative interactions (verbal or nonverbal) that conveyed meaning and went beyond mathematics instructional techniques. Forms of emphasis were identified as word choice, physical gesture, facial expression, stance or posture, vocal stress in syllabication, repetition, and extension.

The next layer of coding involved intensity and quality of interaction; and was based on identifying relational interactions betwee students and teachers. Moreover, it is important to note that culture and language are not categorizable as separate factors. Instead, they interact to define student identity. Specifically, race, language, and culture are interrelated and cannot be analyzed in isolation.
achieved. Any interactions that coders could not agree on were not included in the analysis (see also Battey, 2013, for a more detailed account of analysis).

This study was conducted in one elementary school located in a large city in the southwestern United States. This particular school was struggling to serve their students mathematically; only 16% of African American and 41% of Latino/a students achieved proficient or higher on the state mathematics test in fourth grade the year prior to the research. The teachers in this study participated in ongoing professional development with the second author one year before and after the teachers were videotaped for this research. The goal of the professional development was to support the teachers in designing instruction to build off of their students' mathematical thinking.

Two 5th grade teachers working in this school participated in this research. Mr. Thompson, a white male, and Mr. Gray, a black male, were both in their first three years of teaching. Each classroom consisted of approximately 30 students. All students involved in this study were African American or Latino/a and from lower socioeconomic backgrounds. To keep the content as constant as possible, both teachers taught the handshake problem for one lesson (see Kaput & Blanton, 2001):

Twenty people are at a party. If each person is to shake everybody else’s hand once, how many handshakes will take place at the party? How many handshakes will take place for 21 people? How does the number of handshakes grow every time someone new arrives at the party?

While the teachers worked on this problem with students, they made adjustments and pedagogical decisions based on their students. The two videotaped lessons ranged from 30 to 50 minutes.

Through our analysis, we found that teachers implemented a variety of quality instructional strategies that not only built upon students' skillsets, but also elicited high levels of positive student engagement from students who might have otherwise been withdrawn from learning, or left feeling disconnected from the classroom. For example, teachers used word problems, had students explain and justify their thinking, asked clarifying questions of students, made student explanations explicit through revoicing, and pressed students to detail their mathematical thinking (Carpenter, Fennema, & Franke, 1996; Carpenter, Franke & Levi, 2003; Franke, Kazemi, & Battey, 2007; Franke et al., 2009; Kazemi & Franke, 2004). In addition to what is typically considered mathematics instruction, we also documented the relational interactions in the classroom.

We want to make clear that we are not promoting a cookie-cutter approach for teachers to engage with students. We fully recognize that teachers' individual ways of engaging in quality mathematics instruction looks very different among teachers and varies across grade levels and mathematical topics. Our portrayal of teachers in this study is not holistic, but instead consists of examples of what acknowledging student contributions and accessing language and culture looks like in practice. We believe that we can learn something about teachers' construction of high quality relational interactions with African American students, thus informing teachers and other practitioners about how their own everyday practices can cultivate classroom learning communities that are supportive of all learners.

Our choice to use a mathematics classroom as context for learning that can go beyond the curriculum was to document the experiences of African American and Latino/a students in the hopes of interrupting the deficit notions that often surround their schooling in mathematics. Our goal in writing this paper is to provide models of student-teacher interactions that can promote ways of thinking for teachers themselves to engage in quality mathematics instruction that make connections between math and everyday language and build upon the opulent resources students bring with them into classrooms. It is the interconnectedness of the practices, however, that conveys a teacher’s valuing of students’ culture and mathematical thinking. In the next section, we discuss how the two mathematics teachers went beyond the curriculum and incorporated the resources of students and their families within their everyday classroom practices.

RESULTS

Helping Teachers to Build Upon the Resources of Students and Their Families

In this section, we elucidate how teachers can build upon the resources of students and their families through the incorporation of culturally relevant teaching practices and strategies (Franklin, 1992; Goy, 2010; Howard, 2001a, 2003; Ladson-Billings, 1995, 2009). Specifically, we highlight episodes of positive relational interactions involving two teachers, Mr. Gray and Mr. Thompson. Both recognized the importance of positively acknowledging student contributions in ways that are meaningful to students. Mr. Gray, however, also used his own cultural forms of movement and language, positively framed students' ability in mathematics, and informally engaged students in contrast to the traditional formality of many mathematics classrooms. In engaging these practices, Mr. Gray is caring for the mathematical movement and language, positively framed students' contributions 12 times, of which only one was negative. That means, across all of the interactions coded as acknowledging student contribution, 95 percent of teacher-student interactions in this domain were positive experiences in the two classrooms. Mr. Gray and Mr. Thompson provide us with models of how teachers may use their own classroom practices as a way to recognize and validate students’ mathematical thinking.

Instead of viewing student misconceptions as signifying a lack of mathematical ability (Battey & Stark, 2009), both created learning opportunities for students that promoted high levels of positive student engagement and valuing of their mathematical contributions. They each displayed communicative interactions with students that conveyed messages marked with competence, knowledge, and skill in mathematics.

Mr. Thompson, a fifth grade teacher, was observed acknowledging student contributions 12 times, of which one was negative, during a 50-minute lesson. These interactions included praising a student’s reasoning ability, prompting students to share their mathematical strategy with classmates, affirming students’ efforts to solve problems, and encouraging different ways of thinking and problem solving. He routinely provided encouragement to the students and communicated to students that it is acceptable to struggle with mathematical concepts as a way to be successful. For instance, after introducing the handshake problem to the class, he assured students...
they could solve the problem. Later in the lesson, as Mr. Thompson walked around the classroom stopping at a student’s desk, he pointed to their work and said, “You guys are on the right track.” As he followed up with another group of students working together, he said, “You guys are really close.” A few minutes later, Mr. Thompson again commented to yet another group of students, “Interesting, interesting, that’s a good thought.” Across these episodes, we see how Mr. Thompson consistently recognized students’ thinking and encouraged students to keep working to solve the problem. The message being conveyed is that mathematics is something to struggle through and he wants students to keep going.

Within the same lesson, Mr. Thompson displayed another series of interactions where he acknowledged student contributions as he encouraged and reinforced students’ thinking while they figured out the solution to the problem. For example, while walking around the room looking at students’ work, a student raised his hand and Mr. Thompson walked over to the student’s desk and said: “Thank you very much, Othello.” Bending over to get a closer look at the student’s work, after about 30 seconds, Mr. Thompson said, “Very close on this.” Without pause, Mr. Thompson walked to another group and said directly to a student while pointing to his paper, “James, I really like what you’re doing with these numbers.” He then stretched as he stood up, all the time keeping his eyes on the student’s paper, and then leaned back down to the student’s desk to reassure him he was on the right track in solving the problem. In this instance, Mr. Thompson simply encouraged them to continue without putting down any student’s thinking and reasoning. He later noted their success in solving the problem. These interactions went beyond how he addressed the mathematics of the problem to demonstrate the ways in which he was communicating for students to continue to struggle and that he valued the thinking they were sharing with the class. The consistency of his practices around supporting, challenging, and questioning students’ thinking in mathematics positioned students as being skilled mathematicians. Notably, this is an oppositional stance to how society typically frames the mathematical abilities of African American and Latinx/a students. When classrooms are consistently structured in this type of manner students receive messages that are competent. If the practices were not consistent, then some students might have received messages of incompetence or not trusted Mr. Thompson’s belief that they achieve mathematically.

In our observations of Mr. Gray, we saw him acknowledging student contributions in a different manner. We share this because it is important to represent the diversity of teaching practices that accomplish positive mathematical environments rather than narrow quality teaching to one set of practices. He used physical gestures and facial expressions to show excitement about student thinking individually and in front of the whole class. Again, it is important to note that Mr. Gray was consistent throughout the lesson both in his encouragement of different ways of thinking and in enjoying student success.

While the teachers both positively acknowledged students’ mathematical contributions, and positioned students as competent by recognizing the valid mathematics thinking of students, they did so in different manners. Mr. Thompson encouraged students to struggle and persevere through difficult mathematics. He also noted when students triumphed in solving the problems and he validated students’ strategies. On the other hand, Mr. Gray was more enthusiastic using vocal stress in positive ways, calling students doctor, and initiating the whole class applauding to recognize students contributions. Additionally, Mr. Gray used physical gestures to acknowledge student progress, putting students on the shoulder and fist pumping, showing his excitement in students achieving mathematical success. Across these classrooms, the teachers supported multiple ways of engaging mathematically beyond the procedures, disconnected vocabulary, and note facts often found in urban school classrooms.

Illustrations of Accessing Language and Culture and Reframing Student Ability

While both teachers were adept at acknowledging student contributions, one in particular opened multiple ways to engage in cultural ways of being within the classroom. Specifically, Mr. Gray used informal language practices and reframed students’ ability in relation to broad deficit narratives to support students in building positive mathematical identities. Important to note is that these practices cannot be separated from the ways in which teachers acknowledge students’ mathematical contributions. If the message students receive is that they can use informal language and are capable mathematically, but the teachers’ practices contradict this by not allowing spaces for students to share their thinking, then students might disengage or not feel cared for mathematically. Therefore, it’s the interconnectedness of the two categories and relational practices that support a caring mathematical environment rather than isolated practices.

We conceptualize attending to culture and language as teachers incorporating cultural and multilingual forms, which open opportunities for students to engage in mathematics instruction using their personal knowledge and thinking. In some cases, this may mean the teacher’s acceptance of multiple vernaculars within classroom spaces while students are in the process of understanding mathematical content or demonstrating mastery of
that attending to culture and language is complex, in
they worked individually at their desks. These
practices are considered assets.
structured classroom can be restrictive for some
students. For students from non-dominant groups,
student’s personal cultural knowledge and linguistic
dimensions of culture that can be of importance with
practices, his physical gestures displayed cultural
movements that represented more varied ways of
being than typically found in mathematics classrooms.
We are not suggesting that Mr. Gray’s expressions were about students’ cultural
expressions or ways of being, but simply noting his
own style of teaching displayed movement patterns
not typical in mathematics classrooms.
Continuing to make personally meaningful connections with students, Mr. Gray called a student
doctor” after the student shared his thinking with
the class. Simultaneous to calling the student doctor,
Mr. Gray led the entire class in clapping as a way to
praise the student’s efforts to solve the problem. A
few seconds later, Mr. Gray asked for another student volunteer to show their work to the class. As
the second student approached the board, Mr. Gray
said, “Sir, Professor Suarez. Here is my own
mathematician. Let’s see what you come up with,”
and handed the marker to the student so he could
begin showing the class how he solved the
dishonesty problem. Mr. Gray’s word choices
to name students, doctor, professor, and mathematician
framed students as having ability to achieve
mathematical success. These representations are in
contrast to the ways African Americans and Latin@
students are, unfortunately, generally
portrayed mathematically. Mr. Gray’s regular use of
these terms allowed students to view themselves as
capable mathematically and as members in these
professions. Again, this practice in isolation would
have little impact on students’ mathematical selves.
Coupled with supporting students’ mathematical
thinking and opening cultural ways of being within
the classroom, however, Mr. Gray’s use of these
terms reinforces his belief in students’ mathematical
ability and cultural value.
In the prior section, we noted moments when Mr.
Gray acknowledged students’ contributions in a
variety of positive ways during class. Some
examples included smiling and nodding to affirm a
student’s thinking and putting them on the back.
These interactions were further supported by the
words he chose to encourage a student’s thinking,
reasoning, and problem solving abilities. It is in
these interactions of that students’
contributions are not only positively affirmed, but
relied in a way to students that demonstrated the
belief they are capable math students, thus
interrupting the negative notions of a deficit
perspective. Also important to note is Mr. Gray’s
intentional effort to create a learning environment
where students feel safe to take risks and display
their work publically to other students, consistent
with teaching with caring (Bartell, 2011).

The value in teachers accessing more varied linguistic and cultural forms is paramount. This
interactional domain not only entails what a teacher
says, but also includes ways of thinking and
knowing as it relates to students. Through the use
of culture and language, teachers can reposition
students as having cultural resources rather than
deficits (Arriles, 1998; Galvez & Rogoff, 2003;
Howard, 2002). Much the same as reframing deficit
narratives about ability, this form of interaction
positions students’ ways of being as valid (Batey,
2013; Civil, 2007; Civil & Bernier, 2006; González,
Andrade, Civil, & Moll, 2001). Mr. Gray was skilful in his shifting of language and his ways of
interacting with students that disrupted many notions of
deficit thinking regarding African American
students. For example, while standing next to a
student, looking at her work, he noticed she had
drawn a picture as a way to help solve the problem.
Mr. Gray said directly to her, “Oh this is deep! The
emperor and his new clothes, didn’t know that.”
While still next to the student, he stated to the rest
of the class, “You guys can’t see this yet, only me and
Sarah can see this. This is deep. This is a teacher-
student thing, only she and I can see it.” With the
student smiling and laughing at her desk, Mr. Gray
holds up her work so others can see it and says, “She
got 380,” then displays a “thumbs up” physical
gesture indicating his approval of her strategy.
Students can be heard giggling and laughing in the
background during this time. While this is going on
in the classroom, students briefly stopped working to
pay close attention to Mr. Gray’s more informal
exchange with Sarah.

During the previous episode, Mr. Gray used
informal language and smiling in his classroom. In
moving to more informal language, he opened up
more linguistic ways to engage mathematics rather
than strictly enforcing a formal mathematics register.
This is evident in the student responses to his
language shift. Throughout the lesson, students can
be heard laughing, seeing smiles, and seeing working
diligently for long periods of time to solve the
complex mathematical problems.

Another example of where Mr. Gray intentionally
opened up more ways of being within the
mathematics classroom is when he shared with the
class his personal struggles with mathematics. After
a number of students had shared strategies for the
problem, he noted his own mathematical difficulties, but assured students that they can still understand math.

Now I told you this before, my mind does not think algebraically, and um if I looked at this, I would be thinking, what is a way that I could do this and get the same answer, do it quickly, and I would do this, so, for my mathematician over there, you would probably like this, (pointing to how the problem was solved on the board using an algebraic formula) you guys are sharp, really smart.

Erasing the board to create space to demonstrate another way to solve the problem, Mr. Gray said, "If you're working on that too, it's okay. Don't be ashamed.

Though not mentioned during the class period, Mr. Thompson went beyond positively influencing students' effort and noting their successes, and push back against African American and Latino/a students were the focus of this research, the framework can easily be applied more broadly in multiple contexts and with other student groups. As researchers, we strive for teachers to develop strategies of how they can incorporate practices within their everyday pedagogies that take into account culture, ethnicity, and potential differences in ways that quality instruction may be a common reality for all students, but especially for students from linguistically and culturally diverse backgrounds. We are suggesting that teachers not transcend cultural aspects of students' background, but acknowledge students' cultural holdings and realize some students are framed as incapable mathematically through certain societal vantage points. It is our aim that teachers and practitioners challenge deficit perspectives of African American and Latino/a students and find meaningful ways to support students to learn complex mathematics. Through his own movement, instrumental speech, and word choice he brought culture across the boundary of the mathematics classroom, affirming more ways of interacting in classrooms than are typically allowed. In bringing his personal self into the classroom, Mr. Gray opened different ways of participating in mathematics classrooms while maintaining connections with students.

These types of relational interactions demonstrate the intentionality of the teacher to position students as mathematicians working to solve a problem. Noddings (1988) suggests that students “will work harder and do things...even odd things like adding fractions...for people they love and trust” (p. 10). As demonstrated by Mr. Gray, we contend that by teachers being deliberate in how they interact with students and purposeful in engaging in relational interactions with students that promote willful participation, teachers will positively influence students to engage in mathematics.

A teacher’s intentional use of language can be a powerful way of interacting with students that not only builds trust among students but also fosters a learning environment that is rich in opening opportunities for students’ to bring culture into the mathematics classroom. This can be seen in a teacher moving away from misconceptions and deficit thinking to reframing students’ abilities as mentally able and skillful.

As researchers, we strive for teachers to develop strategies of how they can incorporate practices within their everyday pedagogies that take into account culture, ethnicity, and potential differences in ways that quality instruction may be a common reality for all students, but especially for students from linguistically and culturally diverse backgrounds. We are suggesting that teachers not transcend cultural aspects of students' background, but acknowledge students' cultural holdings and realize some students are framed as incapable mathematically through certain societal vantage points. It is our aim that teachers and practitioners challenge deficit perspectives of African American and Latino/a students and find meaningful ways to support students to learn complex mathematics. Through his own movement, instrumental speech, and word choice he brought culture across the boundary of the mathematics classroom, affirming more ways of interacting in classrooms than are typically allowed. In bringing his personal self into the classroom, Mr. Gray opened different ways of participating in mathematics classrooms while maintaining connections with students.

These types of relational interactions demonstrate the intentionality of the teacher to position students as mathematicians working to solve a problem. Noddings (1988) suggests that students “will work harder and do things...even odd things like adding fractions...for people they love and trust” (p. 10). As demonstrated by Mr. Gray, we contend that by teachers being deliberate in how they interact with students and purposeful in engaging in relational interactions with students that promote willful participation, teachers will positively influence students to engage in mathematics.
connect with students through incorporating language and cultural practices within their student's everyday classroom experiences as a way to open more ways of being mathematically and of being a whole person.

REFERENCES


Native rural and urban students’ mathematical understanding of perimeter and area. Unpublished manuscript. Alaska School Research Fund.


