RUNNING HEAD: Content Learning and Identity Construction (CLIC)

Content Learning and Identity Construction (CLIC): A Framework to Strengthen African American Students' Mathematics and Science Learning in Urban Elementary Schools

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Abstract

We present a theoretical framework that views learning as a process involving content learning (CL) *and* identity construction (IC). We view identities as lenses through which people make sense of, and position themselves, through stories and actions, and as lenses for understanding how they are positioned by others. As people become more (or less) central members of a disciplinary community (e.g., a science or mathematics classroom) and engage (or not) in various cultural practices, changes in identity and knowledge accompany changes in position and status. Identity construction (IC) and content learning (CL) share an important characteristic: they both involve meaning making. For IC, it is the development of reasoned, coordinated, coherent, and meaningful ways of seeing one's self in relation to communities, and for CL, it centers on the development of disciplinary concepts, processes, tools, language, discourse, and norms within practices. Focusing on Black students in mathematics and science classrooms, we claim that three intersecting identities are particularly important: *disciplinary* identity (as doers of the discipline, i.e., mathematics and science), *racial* identity (emerging understandings of what it means to be Black), and *academic* identity (as participants in academic tasks and classroom practices). In this paper, we elaborate on the CLIC framework as a useful tool for understanding how Black students negotiate participation in, and come to see themselves as doers of science and mathematics in their school classrooms. We synthesize empirical findings from our research with younger and older students, as well as with parents and community members, to illustrate dimensions of this framework.

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A Story About a First Grade Scientist

As a rambunctious young boy, Steve usually gets Ms. G's attention. He does not quite sit still during read-alouds or whole-class conversations when the children are supposed to be sitting "crisscross apple sauce" on the rug, but Steve thrives in discussions. Even when he is stretched out on the floor, he shoots his hand up to contribute, or when he inches closer and closer to the book that Ms. G is reading so he can look at the pictures. He asks questions and makes comments. Steve thrives on the way Ms. G orchestrates conversations while reading science information books. Not only is Steve very interested in the science ideas, but Ms. G's dialogic, inquiry-based approach also gives Steve the freedom to move, call out ideas and questions, and make connections to his own experiences.

Steve also thrives on the opportunities that he has to move and talk to his peers during science explorations. As part of the Plant unit enacted in the classroom, Steve and his classmates explore pumpkins by digging their hands inside to pull out the pulp and seeds. They smell and feel the pulp, take out and count the seeds, describe the pumpkin's characteristics in their journals, and then gather on the rug to discuss what they experienced. As Steve describes pulling the pulp out of the pumpkin and feeling it move through his fingers, he tells the class that "something was growing in my hands" and a rich discussion unfolds:

Steve: Something was growing in my hands.
Ms. G: How? Can you explain it?
Annemarie: When I tried to get them out, it was squishy.
[Steve kept saying that the pulp was growing on his hands.]
Ms. G: What happens to the pumpkin when we cut it from the vine?
Student: It dies when the farmer takes it out.
Ms. G: Steve, how can pulp grow on your hands?
Annemarie: I think he's talking about pulp getting longer and spreading because before it was stuck on one place.
Steve: It was stretching down and then it came up.

Steve's use of the word "growing" triggers Ms. G to discuss the difference between living things being alive versus being dead, because she worries that Steve believes the pumpkin to still be alive. But, Annemarie understands what Steve is trying to say and helps clarify his thinking by explaining that Steve does not really mean that the pulp is alive. Rather, he means that it seems to move on its own (which he called "grow") as he holds it semi-vertically in his hand. Steve then takes advantage of the space that both Ms. G and Annemarie have provided and describes what the pulp is doing as "stretching" and "coming up," which are terms that, in comparison to "growing," represent what happens in a more scientifically accurate way.

Steve is thinking, making sense of, and talking about science ideas, taking advantage of the opportunities he is offered for learning science, and being himself in the science class. Steve also expresses his developing science ideas in his journal writing and drawing. His journal entries are messier than some of his classmates' entries, but Steve's journal entries contain solid science ideas. Writing about the pumpkin experience, Steve records his observations in chunks (Figure 1). On top, he writes, "It smells fresh in the pulp inside our pumpkin seed 80." He then draws his pumpkin—an approximately round orange object with a stem, seeds inside, and vertical lines to represent the "grooves" (as he called them) on the pumpkin skin. He continues with text: "I plant a seed in the tree then it busts then I plant a the seed." He finishes by drawing a circle and listing inside it the science words related to the pumpkin: "seed leaf pulp vine plant seed."

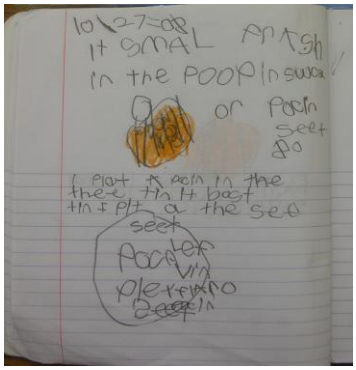

Figure 1. A page from Steve's science journal.

As the year progresses, Steve's class studies solids and liquids. One day, Ms. G builds a concept map with her first graders, an activity usually enacted in science lessons with older students. They have been studying about liquids for a few weeks, exploring different types, such as foamy, bubbly, viscous, transparent, and translucent. Ms. G has these words, written on index cards, on the board, under the heading of "Liquids." She tells the kids that she has gone through their journals and chosen some of the words they have used to describe liquids. One of them is "thick," and she asks where thick might go on their concept map (Figure 2).

Roger:	Thick goes under viscous.
Annemarie:	I think viscous means slow.
Steve:	Viscous is thick so it has to move slow.
Ms. G:	This is a beautiful connection, Steve!

Figure 2. Constructed concept map about liquids in Ms. G's classroom.

Ms. G highlights Steve's engagements in science, praising his contributions. Steve not only makes connections for himself, but he shares them with the whole class and builds on his classmates' ideas. Science makes sense to Steve and, as his teacher offers the class spaces to learn and explore, he seems to feel good about himself.

Toward the end of the school year, Steve talked about being a scientist and pointed out that "you can be important [as a scientist] by focusing on things you need to make then you get it right, but sometimes you don't get it right…scientists keep on going and going until they get it right…[what helps them get it right] is that sometimes they try and sometimes they don't try." For Steve, if scientists "focus," which means that they "listen and get clear what they think," they can get it right. But it is also important for Steve that scientists are not afraid to be wrong because, if they do make mistakes, they can just keep going until they discover what they are looking for (Varelas, Kane, & Wylie, 2011).

In a conversation about his science journal, Steve described one of his favorite entries and one in which he saw himself being a scientist. In this entry, Steve and his classmates were exploring what happens when a napkin is stuffed into the bottom of a plastic cup and then the cup is submerged upside down in a bowl of water. Steve had predicted that the napkin would get wet, but it did not! He kept asking, "How come? How come?" As Steve read the journal page and remembered the activity he had written about, Steve was again filled with excitement and wonderment. He explained that this had been his favorite activity "because the water in the cup makes it seem like you're being bad, but you're not, you're just trying to see the cup in there and see how it's gonna get wet." Steve seemed to indicate that being good in school usually did not go with playing with water. However, he understood that the kids in Ms. G's classroom were not bad because they were playing with water. Ms. G had positioned them as scientists all along, and this was just another opportunity to be scientists by trying to figure out how things work and why.

Steve: A Black[1] Student, Learner, and Scientist

Who is Steve and where does he go to school? Steve is a Black boy who lives on the west side of a big city and attends a neighborhood public school. Almost all of the kids in Steve's school are Black, which is a reflection of the demographics of the neighborhood. When first looking at Steve, we might see a Black boy attending a "low-achieving" urban school in a "poor" neighborhood and make assumptions about his (lack of) preparation for learning science and his engagements with school (Ferguson, 2000). If we did not spend time watching Steve learning in Ms. G's classroom or talk to Steve about his experiences there, we would not know how deeply he engaged with science ideas, the meanings he made as he participated in various activities, how he negotiated who he was within the norms and rules in Ms. G's classroom, who he was becoming, and who he was allowed to be and become in Ms. G's dialogic, inquiry-oriented classroom. As Steve moves through school, he may become a data point in the expanding, and constantly referred to, "achievement gap" in science and mathematics between Black children, on one hand, and White and Asian American children, on the other. But we ask: How much of Steve's complex thinking and meaning making, his detailed observations about the pulp of the pumpkin, and his developing sense of being a scientist along with the practices that scientists is captured and measured by the use of standardized tests that produce an "achievement gap"? And therefore, how do we conceptualize, and study, learning and teaching in ways that can help Black children engage in mathematics and science so that they defy this achievement gap?

Steve's school uses reform-oriented science curricula that the district has encouraged as part of a systemic effort to revitalize mathematics and science education and ensure that all students experience quality instruction. The Full Option Science System (FOSS) and Science and Technology Concepts (STC) units, that the district has adopted and are spelled out in its science scope and sequence for grades K-8, engage students in exploring science concepts and processes, as well as in using fundamental disciplinary practices, like observing, testing, describing, and designing. The hope is that by using well-designed curricula that offer students opportunities to investigate scientific ideas, students of color will come to learn more science content and close the so-called racial achievement gap.

We argue that such efforts, although necessary, are not sufficient for helping Black children learn science and mathematics because they foreground one dimension of learning, namely building content knowledge as the

[1] We use the terms "Black" and "African American" to encompass the diverse ways that group members self-identify and are identified by others. We acknowledge the sociopolitical and power implications of each. We also acknowledge the shared history and experiences of group members despite different labels.

way to increase *achievement*. Integrally connected and intertwined with content learning is identity construction– how children see themselves and how others see them vis-à-vis disciplinary knowledge and practices. Efforts to educate Black children that are motivated by closing the *racial* achievement gap do, in fact, attend to issues of identity. However, these efforts often have the effect of assigning negative, deficit-oriented identities to Black children and making available a limited range of Black identities in relation to science and mathematics.

Steve thrived in Ms. G's science class, not only because he made sense of science ideas and used science practices, but also because Ms. G believed in his "science self" underneath the facade of rambunctiousness, distractions, and requests for attention, and her teaching offered him (and his peers) spaces to think of himself as a scientist. Ms. G's calling has been to teach in this school, one of the many segregated schools in the third most racially segregated large city in the US. Ms. G has been teaching in this school for approximately 8 years, and is concerned with how the neighborhood is changing as Black families are forced to move elsewhere while the area starts to be gentrified, leading to decreased enrollment and student attendance in that school. Ms. G knows that Steve needs to learn science, but she also wants to positively affirm Steve's emerging Black racial identity while he learns science.

In this paper we discuss a pedagogical and research framework that views school learning as a process of content learning (CL) *and* identity construction (IC), and attends to the ways in which these processes interact influencing the degree to which students succeed in mathematics and science. We focus on African American students in particular because they are typically positioned at the lowest level of learning and succeeding in mathematics and science (Aud, Hussar, Planty, Snyder, Bianco, Fox, Frohlich, Kemp, & Drake, 2010; Secada, 1992; Strutchens & Silver, 2000; Tate, 1997; Vanneman, Hamilton, Baldwin Anderson, & Rahman, 2009). We discuss the essential elements of the framework and show how findings from our prior research in mathematics and science education have motivated its development. We also suggest ways that teachers may use to intertwine CL and IC in their classrooms, along with research goals consistent with our framework.

CLIC: A Pedagogical and Research Framework

We consider learning as a sociocultural activity that encompasses interactions among people, artifacts, and ideas in socio-historical, cultural spaces that people shape, and are shaped by, as they act and interact within these spaces. "Because learning transforms who we are and what we can do, it is an experience of identity… We accumulate skills and information, not in the abstract as ends in themselves, but in the service of an identity. It is in

that formation of an identity that learning can become a source of meaningfulness and of personal and social energy" (Wenger, 1998, p. 215).

A growing literature suggests that learning is also a sociopolitical activity where issues of authority, power, and hierarchy affect social relations, access to ideas, and positionings that learners of a particular socially constructed racial group, ethnolinguistic affiliation, class, gender, and so forth, must negotiate. Learning involves a dialectical relationship of agency and structure, which, in turn, are influenced by the sociohistorical, collective experience of a group of people who share aspects of a particular social identity such as racial group membership. Learning and participation should be considered not only as cultural, cognitive, and social practices but also as *racialized forms of experiences* (Martin, 2006) that unfold at different levels of analysis–sociohistorical, community, school, classroom, and/or individual.

As a sociocultural and sociopolitical experience, learning any subject matter is about developing competencies related to this discipline and "a way of being in the world" (Wenger, 1998, p. 151) relative to the discipline. It is, thus, the intertwining of constructing knowledge with others and constructing the self as a learner while participating and socializing in discipline-related practices. It is a process of content learning (CL) and identity construction (IC)–hence naming our framework **CLIC**.

Identities are lenses through which we position ourselves and our actions, and through which others position us. They are **stories** we, and others, tell about ourselves (Sfard & Prusak, 2005)–*identities-in-narratives*. But, they are also **performances** we enact as we interact with others (Gee, 2002; Holland, Lachicotte, Skinner, & Cain, 1998)–*identities-in-practice*, carved out in "figured worlds" peopled by figures, characters, actors, who carry out tasks with distinguishable perspectives, styles, and orientations. As people become more (or less) central members of a community (i.e., a classroom community), changes in identity accompany changes in position and status (Berry, 2008; Carlone & Johnson, 2007; Jackson, 2009; Tan & Barton, 2008; Varelas, Becker, Luster, & Wenzel, 2002). Changes in position and status, in turn, offer people different opportunities to engage with ideas, constructs, processes, and artifacts that are available in the community in narrated and performed ways. Thus, identity shifts are integrally related to knowledge shifts and together they signify that learning–a change in knowledge, skills, dispositions, efficacy, and habits of mind–has occurred.

What is also important to consider relative to identity construction is that it involves a constant negotiation between *actual* and *designated* identities (Sfard & Prusak, 2005). Actual identities are based on who people believe

themselves to be at any particular moment, and how they perform their selves. Designated identities are based on what people *expect* to be the case, if not now, then in the future. Designated identities have the potential of becoming part of people's actual identities, and they express wish, commitment, obligation, or necessity. People may expect to "become" a certain kind of person perceiving this becoming as good for them. People may also see a designated identity as inevitable for those of the same sociocultural origin, or the type of future they are destined to have according to others (i.e., parents, teachers). Their agency may be inhibited because of the limited range of designated identities that are available to them as a result of macro level forces and structures. In Steve's case, the designated positioning of students who play with water in the classroom as "bad" students was entangled with Steve's actual positioning by himself and others, such as his teacher and peers, as a scientist who observes and tries to find out what happens. Moreover, his actual positioning as a meaning maker and a thinker was knotted with his designated positioning as a student who was attending an underperforming school.

With respect to knowledge construction, engaging students in using tools, practices, and ideas of a disciplinary domain, even with ways that relate to their own everyday experiences, is necessary but not sufficient to develop deep and broad understanding of a knowledge domain (Bransford, Brown, & Cocking, 1999). What is needed is explicit, continuous, systematic, and extensive building of connections among the various experiences and underlying concepts and processes. Similarly, with respect to identity development, using pedagogical and curricular approaches that value students' meaning making, funds of knowledge, experiences in the world, and cultural ways of being is not enough for them to develop positive identities in relation to a disciplinary domain. These considerations are especially relevant for students who have been historically portrayed as underachieving and underrepresented in mathematics and science, and who have experienced schooling in constrained ways. Such students need to be explicitly positioned by themselves and others as capable doers of science and mathematics and in ways that build strong connections between their racial and ethnic identities and their disciplinary identities.

Focusing on Black children in mathematics and science classrooms, we claim that at least three identities are particularly important to attend to: *disciplinary* identity (as doers of the discipline, i.e., mathematics and science), *racial* identity (as African Americans), and *academic* identity (as participants in academic tasks and classroom practices). Supporting and understanding the ways in which these three identity construction processes (in narrated and performed contexts, and in actual and designated forms) interact, overlap, diverge, and develop together, and along with content learning in classrooms, are necessary if we are to support Black children's learning of

mathematics and science. Figure 3 schematically shows the four pillars of the framework and their possible overlaps numbered for easier reference later in the paper. Below, we discuss examples from prior research we have conducted in mathematics and science education to point to the necessity and fruitfulness of this framework.

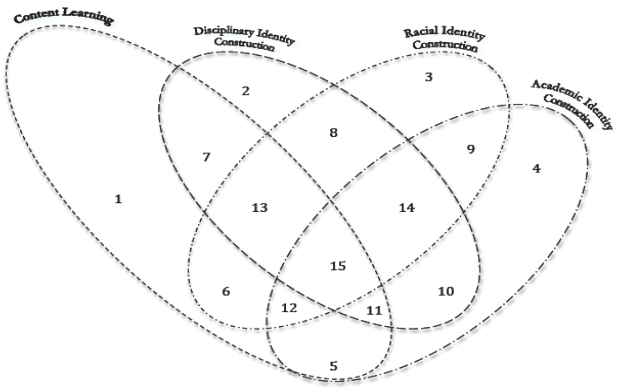

Figure 3. Schematic representation of CLIC framework

CLIC: Its Roots and Research Base and Potential

Considering racial identity together with disciplinary and academic identities among Black children is important for multiple reasons. To date, emerging research shows that Black children's mathematics identities are strong correlates of their mathematical success or failure and that teachers' classroom practices and beliefs can dramatically shape these identities–not just for the short term but also over life spans (e.g., Berry, 2008; Jackson, 2009; Martin, 2000, 2009; McGee & Martin, 2011a, b; Spencer, 2009; Stinson, 2009). Moreover, studies of racial identity among African American adolescents show that positive racial identities can promote positive academic identities and achievement and can serve as a buffer to a number of risk factors (Chavous, Bernat, Schmeelk-Cone, Caldwell, Kohn-Wood, & Zimmerman, 2003; Harper & Tuckman, 2006). In science education, research has shown that practices that allow and nurture Black students' ways of being and authoring themselves in the context of science teaching and learning in school and out-of-school contexts, are critical in their participation in, and learning of, science (Brown, 2006; Elmesky, 2011; Elmesky & Seiler, 2007; Emdin, 2010; Olitsky, 2006; Parsons, 2008; Seiler & Elmesky, 2007; Tobin, Elmesky, & Seiler; 2005; Varelas et al., 2002). Thus, a framework that strongly emphasizes constructing racial identities simultaneously with disciplinary and academic identities along with disciplinary knowledge is necessary in order to help African American children succeed in science and mathematics. As noted by Perry, Steele, and Hilliard (2003):

> [B]efore we can theorize African-American school achievement, we need to have an understanding of what the nature of the task of achievement is for African Americans *as African Americans*…the ideology of the larger society has always been about questioning the mental capacity of African Americans, about questioning Black intellectual competence…[What is needed is] a careful examination of all aspects of the school, with an eye toward understanding how the school's day-to-day practices participate in the creation of underachievement. (pp. 4-9, italics in original)

Salience of Racial Identity

Danny Martin's research with Black children and adolescents, college students, and parents has established the interconnectedness of racial and mathematics identities by addressing two questions: *what does it mean to be Black in the context of mathematics learning*?; and *what does it mean to be a learner and doer of mathematics in the context of being Black*? (Martin, 2000, 2006, 2007, 2009, 2012) In this work, various constructs related to racial identity have surfaced as important, especially the constructs of regard and centrality. Centrality refers to the extent to which a person normatively defines her/himself with regard to race and indicates whether race is a core part of an individual's self-concept (Sellers, Smith, Shelton, Rowley, & Chavous, 1998). Regard, refers to a person's affective and evaluative judgment of his/her race. Regard consists of a private and a public component. Private regard refers to the extent to which individuals feel positively or negatively towards African Americans and their membership in that group. Public regard refers to the extent to which individuals feel that others view African Americans positively or negatively. Martin's work is suggestive of relationships that might exist between regard and actual and designated identities. For example, actual identities with respect to race–who people believe themselves to be at any particular moment–might reflect a negotiation between one's private regard and one's interpretation of public regard about what it means to be Black. Similar relationships and negotiations might exist between designated identities and public and private regard. What one expects to be the case (i.e., designated identity) may reflect the influence of one's beliefs about public regard for particular identities.

Focusing on the construct of *centrality*, Martin's research has shown that racial and mathematical identities are key considerations in Black learners' self-concepts and that these identities are often *co-constructed* and negotiated in situations and activities where *Blackness* and *mathematics competence* emerge as highly salient. In the excerpt below, from Martin (2006), an African American father and community college student named Keith asserts

his positive mathematics identity but also discusses how aspects of both his mathematical and racial socialization generated a counternarrative about Black participation and competence in mathematics.

Keith: When I was in third grade, I was actually the brightest kid in school and that's where my knack for math came from. I actually exceeded all the math that they had there. They had nothing else for me…. Then when I made it to fifth grade, my mother put me in a Catholic school…. And this is in 1968 or 1969. The nun told me at that time that blacks should not consider professional occupations. It was my goal to become a physician. So, I gave up.
Danny Martin: How confident were you in your math ability?
Keith: That was never an issue. I just never had the push. I did not apply myself because I did not have anyone behind me encouraging me…. I didn't have anyone around me saying '[If] you do math, you're going to go here [in life]. You can be a doctor if you just hang in there. Take a science class…. You have potential Keith. If you work, do you realize that you won't be able to get your algebra homework done?'… No one took the time to say 'Why don't you join the math club? You know, they got a special program for African American students at Illinois Institute of Technology.'…. Could you imagine? My whole world would be different. I wouldn't even be sitting here with you having this conversation.

Martin's work with adult respondents, who are able to reflect on their experiences as children and adolescents, has highlighted these early experiences as a place for more empirical work with Black children to better understand their early mathematics socialization across multiple contexts, including schools and classrooms, and as a way to understand how these experiences shape their emerging mathematics and racial identities. Keith's narrative includes references to how interpretations–his own and those of others–of his *being Black* shaped his mathematics identity via the academic opportunities that were available to him, an example of how the intersection among racial, disciplinary, and academic identity construction (section 14 in Figure 3) may unfold.

Martin's work (2000) has also shown how middle school students' racial identity shapes their academic identity–an example of what may populate section 9 in Figure 3. Consider Jasmine's response below.

Danny Martin: How far do you want to go in school?
Jasmine: I'm going to either Howard or Harvard.
Danny Martin: Why do you want to go those schools?
Jasmine: I want to go to Harvard because I want to achieve something and they wouldn't expect a Black person to be at Harvard.

Jasmine's use of "they" is likely a marker for whites and the larger society, and indicates that the student, even at the middle school level, is aware of how Black identity is constructed in societal and institutional contexts.

What is particularly important about the examples from Martin's research is that they provide evidence that *being Black*–based on the meanings constructed by the participants and their interpretations of the meanings constructed by others–emerges as both salient and central in the context of schooling, more generally, and mathematics learning, in particular, and that it does so across the life span. In framing what it means to be Black and

a good student, both Keith and Jasmine are cognizant of the fact that many in the larger society believe African Americans to be inferior. However, they are undeterred by these meanings in their pursuit of success.

Academic Identity and Its Influence on Disciplinary Identity

Maria Varelas' and Justine Kane's research with students of color (Black and Latino/a) has shown how academic and disciplinary identities become intricately fused as students try to make sense of the disciplinary practices of science in which they engage, and of the institutional norms of schools and schooling that they experience (Kane, 2009, 2012a, 2012b; Tucker-Raymond, Varelas, & Pappas, 2007, 2013; Tucker-Raymond, Varelas, Pappas, & Keblawe-Shamah, 2012; Varelas, Kane, & Wylie, 2011, 2012). In one study, Varelas and Kane (Varelas et al., 2011) uncovered how young primary-grade Black children, in almost exclusively Black schools and in classrooms where their teachers attempted to engage them in meaningful scientific practices, were constructing academic and science identities that included conflicting practices, behaviors, ideologies, and habits of mind.

For some children, elements of good school behavior and following school rules, that were part of their developing actual academic identities, but also their designated ones, either overpowered or co-existed with the science identities of messiness, non-linearity, questioning, and wonderment (Varelas, House, Wenzel, 2005) that their teachers were helping them develop. Pricilla saw herself as a scientist by being "nice," and because "When I work, I try to keep my mind on science instead of keeping my mind on playing, talking, talking about stuff that it ain't schoolwork or homework. And also nice because sometimes kids misbehave, talking back to the teacher and call her names." Jaleesa saw herself as "kind of good" in science; "You're supposed to always study on stuff…and you always supposed to get good grades…and be good to the teacher and then say nice things about her." And Tanya echoed similar ideas: "Scientists can teach kids a valuable lesson like not to hit people and not to push nobody, not to talk when the teacher is talking." At the same time, though, that Pricilla was using school markers to position herself in science, she also used science markers like other students did: "You do good experiments on science...like scientists // they can go out and explore everything, and can explore the wild. They can go into the forest and try and find animals and everything. They can discover animals that sometimes people don't even know about." In contrast to students who fused school and science markers, other children positioned themselves as scientists by referring *only* to scientific practices. Clayton was a scientist "when we build with blocks and have to tell about it." Antoine was a scientist when he built things but also when he "observe[s], write[s], grow[s], like

growing plants." For Antoine "scientists test [things] out," which was something he wanted to do, but had not yet done.

The underlying ideology of the academic identity that these children were constructing was marked by compliance, control, regulation, and rightness, but the underlying ideology of their science identity was marked by exploration, questioning, challenging ideas, seeking understanding, and making mistakes. For example, Steve, who we discussed at the beginning of the paper, shared: "You can be important by focusing on things you need to make then you get it right, but sometimes you don't get it right." These findings present an example of how academic and disciplinary identities may unfold in classrooms differently for different students (section 10 of Figure 3). Moreover, juxtaposing student identities-in-narratives with classroom practices revealed that fusing doing school and doing science occurred more often in classrooms where there was a stronger emphasis on appropriate school behavior consistent with norms of no talking without being called on, limited movement, and compliance to teacher's directions. Thus, in their ideological becoming, the children refracted dominant voices in their classrooms, voices that encouraged or discouraged their ways of negotiating science and school identities.

In another study, analyzing both the ways a class of Black 3rd graders spoke about or narrated their experiences of school and science *and* the ways they performed themselves in the moment-to-moment happenings of the science class throughout one whole school year, Kane (2009, 2012a) found that children constructed a consistent sense of who they believed themselves to be as students and science students / scientists and how they acted in the science class, albeit differently from each other (another example related to section 10 of Figure 3). The study further showed that the ways the children felt positioned by their peers and teacher influenced the ways they perceived themselves, and the kinds of social spaces the children encountered in school served to help or hinder positive self-perceptions and performances relative to science and school.

For example, Tamara liked to talk and draw about her ideas as a way of coming to a greater understanding of science. She enjoyed being actively involved in the acting out of drama activities, in hands-on explorations, and in composing her own information book. She did not seem concerned with finishing the task quickly or checking to see if her answers were correct. For Tamara participating in class was a way of understanding better. However, Tamara felt that some of her classmates were impatient with what they perceived to be her lack of "right answers," and her need for time to think. They would call out the answers for her if she took too long to respond, and they

would "holler at" her if she made a mistake. Consequently, Tamara preferred to work only with her friends and was reluctant to speak out in class, preferring to perform the role of helper to her teacher and classmates.

In contrast, Joe thought of himself as a quietly attentive learner, but an inquisitive scientist. For Joe, being "smart" meant listening quietly so he could learn, as opposed to his classmates whom he saw as loud and boisterous. Joe recognized that his teacher wanted him to actively participate more, but, for Joe, listening in class was a way to learn new ideas. When the teacher read a science book about new or interesting ideas, Joe showed increased interest and participation in the form of questions. Joe's creative and insightful questions demonstrated the depth of his thinking. Both Joe's teacher and his peers recognized his knowledge and creativity and valued his help when they needed it. His classmates often came to him for help, and Tamara recognized that she could trust Joe to never "holler at" her. However, Joe seemed less concerned with completing assignments than with learning new ideas, and when the ideas were not particularly interesting to Joe, he laughed and played around with his friends. Both Joe's teacher and classmates recognized that he was not living up to his potential. Describing Joe, Kimberly said, "He *real* smart, but he just don't want to use it. He just want to play…around, but he really smart." Joe seemed aware of and unconcerned about this perception of him.

Yet another dimension of the interplay between academic and disciplinary identity construction has been revealed in Martin's (2000) work where he identified the invocation of personal and academic agency as two ways that Black middle school students challenged the dominant narrative that focuses on failure and compelled them to maintain their identities as good students. Martin showed that mathematically successful Black students are adept at exercising agency by navigating their way through the mixed messages about mathematics that come from society, their communities, schools, families, teachers, and peers, in order to negotiate, and maintain, their identities as successful students and legitimate doers of mathematics. For example, Samantha exhibits such agency in the following conversation.

Danny Martin:	What do the other kids think about you? Do they think that you're good at math?
Samantha:	Yeah, they call me names because I get good grades.
Danny Martin:	What do they call you?
Samantha:	Like nerd and stuff, things like that.
Danny Martin:	How does that make you feel?
Samantha:	It doesn't really bother me, I don't listen to most of the negative things that people tell me.
Danny Martin:	Ok. How much confidence do you have? Like in your ability to do math.
Samantha:	A lot. Like if someone tells me that I can't do something, I never believe what they tell me because I know I can always do what I want to do if I put my mind to it.

As Black children–across all achievement profiles–negotiate their academic, disciplinary, and racial identities while engaged in content learning, they develop various forms of agency that contribute to their success and failure and to their emerging identities. In order for Samantha to continue seeing herself as a good mathematics student, she had to resist the negative comments made by some of her peers. Her resistance and her belief that she "can always do what I want to do" reflect the fact that she was an active, rather than passive, participant in defining herself and how she wanted to be seen by others.

Identity Construction Interwoven with Knowledge Construction

Our prior research has also shown how Black students' identity construction is intertwined with content learning in mathematics and science. Martin (2000) has shown that Black learners can form strong disciplinary identifications with mathematics based on their understanding of the subject matter. Annette, an African American 8th grader who was in an accelerated mathematics track, ahead of her peers by two years, liked math because of the ease that she had with it–"I like math. I can just see it sometimes. It just comes to me all of a sudden. I'm looking at a problem and I know what the answer is. Math is kind of easy to me…I don't want to sound vain but I think I'm in the top…I pretty much know what I am talking about most of the time." This is an example of how content learning and disciplinary identity construction come together in a student's narrative (section 7 of Figure 3). This example also provides an indication of the expanded range of identities that Black children can develop in relation to mathematics. While some students in Martin's study identified mathematics as being important for instrumental reasons, others like Annette identified with mathematics as an area of study and wonder.

Varelas and Kane (Varelas et al., 2011), in their study referred to above focusing on early grade science classrooms of African American children, showed yet another construct that lies in the intersection of content learning and disciplinary identity and academic identity construction (section 11 of Figure 3). "Smartness" was part of the children's ideological becoming relative to science and scientists. Although the standard dictionary definition of smart is "quick or prompt in action; clever, witty, or readily effective, as a speaker; having or showing quick intelligence or ready mental capability," the children had constructed "smartness" as acquiring large amounts of knowledge. In fact, 3rd grader Raymond articulated the distinction he drew between clever and smart. Raymond shared, "Different things about clever and smart is that clever means that you gotta think of a way. And smart is different from clever because you gotta know stuff." Thus, in several children's science identity and academic identity construction, "cleverness" was sacrificed for the vastness of knowledge required, despite efforts of their

teachers that year to emphasize thinking, connecting ideas, coming up with ideas and questions, challenging ideas as part of learning science and being / becoming a scientist.

In addition, Varelas with Eli Tucker-Raymond and other colleagues have examined in a series of studies (Tucker-Raymond, Varelas, & Pappas, 2007, 2013; Tucker-Raymond, Varelas, Pappas, & Keblawe-Shamah, 2012) how young mostly Latino/a and African American children across 1st-3rd grades drew and talked about instances when they were scientists. The studies used a pre-mid-post design to explore changes relative to the children's positioning vis-à-vis the practice of science as they spent a year in their classrooms exploring science in extended units engaging with texts, hands-on explorations, writing, drawing, acting out, muraling, and talking science. As time went by and children were learning science, they came to see themselves as more similar to scientists out in the world in terms of material, cognitive, textual, social, and affective processes. They also recognized that scientists might use different materials than they were using, but that had little effect on the way they saw the processes in which they were engaged as being similar to those of scientists. That is, children may have seen the details of the specific activities as different from scientists, but they thought like scientists, they socialized like scientists, they read and wrote like scientists, and they were affectively engaged in science in ways that were commensurate with the activities of scientists out in the world. For example: Jonah drew himself as a scientist examining worms, but also noted that "scientists have tools to cut a worm and see what it is," and he did not have such tools; Antonia said that she was a scientist because scientists "want to be creative doing something they really like to do"; and Lawrence, who was a scientist exploring whether raisins sink or float and dissecting worms, associated himself with scientists because they "want to get better for compliments." Recognition, which brought about pride and a good feeling for Lawrence, was a part of his disciplinary identity.

Significantly, there was also a consistent increase over time in cognitive and textual processes that the children mentioned. Cognitive processes that were almost absent in the pre-assessment were abundant in the post-assessment. Moreover, students perceived almost exclusively similarities between themselves and scientists out in the world. For example, Kenny said that scientists engaged in experiments, like the one his class had done on evaporation, "so they could learn from it" and "teach themselves about evaporation." Scientists also "predict" which he did, too; his classmate Tia was a scientist because "scientists have great ideas." Textual processes to which children also referred were offered as similarities between the children and scientists. Although children drew consistently more hands-on type activities than those primarily involving print, children's descriptions of print

activities were increasingly complex, and more canonically scientific. For example: Jamar said, "scientists have to draw every day or once a week," and so did he as a scientist; and Rhonda associated herself to a scientist because they "write and draw so they don't forget."

Students were more able to think about and represent themselves as scientists as the year progressed, and there were no differences between boys and girls. This finding not only shows how young children construct disciplinary identities when offered opportunities, but also provides evidence that the pattern of female students and students of color having poorer self-images than males and European Americans when it comes to who can be a scientist (Finson, 2002) is reversible in the context of intentional disciplinary identity construction.

CLIC as a Potential Research Tool

Our prior research points to the salience of various constructs that are related to identity construction and content learning in school mathematics and science education contexts. Such constructs include obedience, resistance, performance, competence, authority, knowledge, and agency, among others. What seems particularly fruitful in terms of the CLIC framework is to continue to identify the complex ways in which these constructs interact with the three dimensions of identity construction and content learning for African American students. Certainly, these constructs do not become elements of Black students' identities vis-à-vis mathematics and science in the same ways or to the same degree. Moreover, for different students, these constructs are found in different intersections of IC and CL.

For some students, the construct of *obedience* may land at times in section 9 (intersection of racial and academic identity construction): as Black students, they need to follow school rules and stay out of trouble so they can be seen as good students. For others, obedience may land at times in section 10 (intersection of academic and disciplinary identity construction): they see themselves as capable of doing mathematics or science, only when they follow the class norms, be quiet, pay attention, and follow the teacher's instructions. For some students, the construct of *knowledge* may land at times in section 13 (intersection of content learning, and racial identity and disciplinary identity construction): they see themselves as capable Black mathematicians or scientists when they understand why things work in a particular way. For others, knowledge may land at times in section 5 (intersection of content learning and academic identity construction): they see themselves as good students when they have mastered particularly difficult mathematical or scientific ideas. Yet, for others, knowledge may land at times in section 6 (intersection of racial identity construction and content learning): they believe they know a lot about

science or mathematics and that makes them feel positively about being Black. These sections are highly dynamic, with the possibility of constructs landing in more than one section and changing in short or long time intervals. Thus, we view these sections as tools that will help us better explicate the nature of the constructs and their interactions, and capture the range of ways in which Black children engage with, and learn, mathematics and science.

Recommendations for Practice and Research

We find Anderson's (2007) framework, drawn from the work of Wenger (1998), helpful in thinking about the particular ways in which students could engage so that they build *explicit* connections among who they are and are becoming, their engagement and positioning during disciplinary activities, and their content knowledge. Three of what Anderson called "faces of identity" can guide practitioners in helping students develop such connections: (a) *reflecting* on their engagement in disciplinary (mathematics and science) practices; (b) *imagining* and representing themselves doing mathematics and science in and out of school, and now as well as later in life; and (c) *aligning* themselves with disciplinary practices by imagining professionals / disciplinary practitioners and considering similarities and differences between themselves and these practitioners.

Ongoing and explicit engagement with ideas about identity construction offers students the opportunity to examine and share their sense of self, revisit it, rebuild it, revise it, responding both to the cumulative and the at-the-moment experiences in their classrooms. Thus, tasks that ask students to think about, and share, who they are and who they are becoming as African American mathematics and science students can become the narratives in relation to which student identities evolve. People need to develop and maintain satisfying and meaningful narratives related to a community, a practice, or a group in order to identify with it (Ezzy, 1998). Such pedagogical practice may also offer teachers windows into their students' identity construction and, thus, opportunities for scaffolding. Especially for children in urban schools, beliefs about "possible selves" influence children's academic achievement (Oyserman, Bybee, & Terry, 2006) in all subject areas, including science and mathematics.

In Table 1 we offer examples of prompts that can be used in such tasks. Such tasks may take various forms: periodic journal writing, completion of an "exit ticket" (a quick note at the end of a lesson), a "bellringer" (a 2-3 min task at the beginning of the lesson), an "acting out" assignment (improvisational dramatic act), a "Me" box for younger students (a container with objects/images that students find appropriate for representing them relative to science and mathematics).

Table 1: Prompts for Tasks Aimed at Identities-in-Narratives

Reflecting on disciplinary engagement
I usually give my best effort in my mathematics/science classroom if…
It's important for me to show my teacher/classmates that I am good in mathematics/science because…
Mathematics/science are important parts of my school (out-of-school) life because…
What I like best (or least) about doing mathematics/science is…
Imagining and representing self in disciplines
I am good in doing mathematics/science because…
I want to be better at mathematics/science because…
…shows that I am good in doing mathematics/science
Doing mathematics/science can be helpful to me in these ways…
What my teacher (or classmates) thinks of me doing mathematics/science is…
Aligning self with disciplinary practices
What do I do in mathematics/science that mathematicians/scientists do (or don't do)?
What is most (or least) important in doing mathematics/science?

Creating classroom spaces where students think about, compose, and share narratives about who they are and are becoming vis-à-vis science and mathematics is not only a pedagogical tool, but also a research opportunity. Understanding the various ways in which Black children construct identities intertwined with content learning may shed light on resources, factors, and types of experiences needed so that they can succeed in mathematics and science classrooms.

However, as Kane (2009, 2012a) has argued, in order to understand student identity construction in classrooms, attention is needed to student identities not only in *narrated* contexts (the stories, or narratives, they develop about who they are and how they are positioned) but also in *performed* contexts (the identities-in-practice that they perform in the classroom). Considering the three types of identities that are important in the CLIC framework, we offer three sets of questions as analytical tools for thinking about, and for understanding, construction of identities performed in the science and mathematics classroom (Table 2). These sets of questions compel us to explore the dialectical relationship between patterns and degree of engagement in classroom practices, on one hand, and students' opportunities to learn content and develop identities as African Americans and as doers of mathematics and science, on the other.

Table 2: Questions for Exploring Identities-in-Practice

About disciplinary identity
How are students more or less central members of the mathematics/science classroom?
How are students seen as competent in mathematics or science?
Which mathematics/science practices, language, norms are students engaged in and how?
How are students supported (or not) in engaging with mathematics/science language, practices, norms?
Do certain practices encourage more or fewer students (and who among them) to see themselves as doers of mathematics/science?

About racial identity
How do students assert and negotiate their African American identities in their mathematics/science classroom?
How are students encouraged, challenged, and supported in engaging in classroom practices to build strong African American identities?
What practices encourage students to embrace strong African American identities, and which students respond to which practices?
About academic identity
How are students positioned, and how do they position themselves, as strong, knowledgeable, curious?
How do students' succeed (or not) in the mathematics/science classroom?
How do students engage (or not) with schoolwork?
How does the teacher engage a range of academically successful students in mathematics/science practices?
How do students support (or not) each other in academic tasks?

As practitioners and researchers, when attending to identities-in-practice, we need to consider Black students as members of two groups: (a) classroom communities where issues of hierarchy, power, marginalization, inclusion, success, failure, agency, and structure get negotiated and develop over time; and (b) a social group that has historical relationships with institutions such as schools where meanings associated with, and beliefs about, what it means to be Black have direct relevance to dynamics and outcomes of teaching and learning.

Concluding Thoughts

Drawing on our empirical and theoretical research with Black learners, as well as our interpretations and reformulations of sociocultural and sociopolitical perspectives on learning and participation, we have introduced a framework (CLIC) that calls for integration of content learning (CL) and identity construction (IC). We argue that attention to either one of these is necessary but not sufficient. Content learning and identity construction are intertwined processes that unfold at many different contexts and across many different timescales, but also share an important characteristic: they both involve meaning making. For identity construction, it is the development of reasoned, coordinated, coherent, and meaningful ways of seeing one's self within communities, and for content learning, it centers on the development of disciplinary concepts, processes, tools, language, discourse, and norms within practices. We further suggest that Black children who study mathematics and science negotiate identities not only as students and doers of mathematics or science in the context of their classroom practices, but also as members of a social group whose racial identity is salient and often subject to negative characterizations in school and other societal contexts. The CLIC framework attends to these three identities (academic, disciplinary, and racial) offering a pedagogical and research approach that may be helpful in promoting Black students' success in science and mathematics, explicating what learning these subjects entails, and examining the active constructions of Black children's emerging selves.

Regarding pedagogy, espousing an approach that emphasizes both content learning and identity construction necessitates that instructional (and assessment) practices focus on both learners' developing understanding of concepts, processes, skills, and practices of a domain, and their developing sense of who they are and who they are becoming. The evolving sense of being and becoming–the identity work that students do in conjunction with learning the content of a discipline–may be the "missing link" that holds clues about Black students' participation in mathematics and science in school and in life. In many classrooms, identity work is often considered secondary to constructing knowledge, or a residual product of developing (or not) a strong knowledge base. As teachers of science and mathematics, we focus on making content meaningful and engaging for our students hoping that, if we succeed, they will position themselves, and will be positioned by others, as good students and good doers of these subjects, and with a strong sense of their Black racial identities and high probability for success relative to these fields.

Indeed, increased knowledge could lead to constructing or strengthening positive identities, but two issues raised in this paper complicate this relationship: (a) identities also influence opportunities to learn (they are not only the products of learning), and (b) identities are constructed by individuals as they make sense of themselves relative to others in their figured worlds, and, thus, are determined by the ways that an individual negotiates the dialectic of agency and structure that could be different from others' ways. This implies that, as teachers, we need to infuse in our lesson plans time for students to think about their identities in the same way we give them time to think about concepts and practices they are learning and how they are useful to them. An explicit, in-depth, and extended processing of identity work will enable students to understand their self and the subject matter they are learning in unison, using one to leverage the other. We argue that this is particularly important for African American students, many of whom are surrounded by rhetoric at a micro-, meso-, and macro-level contexts filled with negative stereotypes and innuendo about Black competence (Nasir & Shah, 2011), emphasis on the achievement gap, and often limited framings of who they are and who they can become.

Regarding research, the CLIC framework encourages us to consider intersections of identity construction and content learning, and to seek multidimensional ways with which to capture the identity work as mathematics and science learning unfolds in a classroom as well as when it reaches milestones (i.e., at the end of the year or at the end of every curricular unit, etc.). The framework can be used to understand the ways in which content learning and identity construction are intertwined from two perspectives: from the perspective of identities-in-practice that

co-evolve with meaning making of science and mathematics ideas in the classroom; and from the perspective of identities-in-narratives that students tell about themselves and their place in mathematics and science at various points of their classroom life. Juxtaposing these two perspectives will shed more light on the complexities of identity work in which students engage. The CLIC framework also accommodates an expanded range of identities and highlights the fact that Black children can move back and forth among various identities as well as carve out new ones based on their experiences in the classroom and other contexts.

Moreover, the CLIC framework urges us to investigate and interrogate whether neatly unstitching various identities is possible at the empirical level, and, if so, what this unraveling may reveal for different students both in the moment and over longer periods of time and academic trajectories (Johnson, 2012). We ask this plausibility question because we are reminded by Freire (1992/1994) that the identities we wish to study can be elusive and never clearly visible, shielded by all the factors that *shape* the identity:

> Never does an event, a fact, a deed, a gesture of rage or love, a poem, a painting, a song, a book, have only one reason behind it. In fact, a deed, a gesture, a poem, a painting, a song, a book are always wrapped in thick wrappers. They have been touched by manifold whys. Only some of these are close enough to the event or the creation to be visible as whys. (p. 10)

We argue that CLIC allows us to get close enough to student identities to help make visible the whys which help shape them.

References

Anderson, R. (2007). Being a mathematics learner: Four faces of identity. *The Mathematics Educator, 17,* 7-14.

Aud, S., Hussar, W., Planty, M., Snyder, T., Bianco, K., Fox, M., Frohlich, L., Kemp, J., & Drake, L. (2010). *The Condition of Education 2010 (NCES 2010-028)*. Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Berry, R.Q. (2008). Access to upper-level mathematics: The stories of African American middle school boys who are successful with school mathematics. *Journal for Research in Mathematics Education, 39,* 464-488.

Bransford, J.D., Brown, A.L., & Cocking, R.R. (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Brown, B.A. (2006). "It isn't no slang that can be said about this stuff": Language, identity, and appropriating science discourse. *Journal of Research in Science Teaching, 43,* 96-126.

Carlone, H.B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching, 44*, 1187-1218.

Chavous, T., Bernat, D., Schmeelk-Cone, K., Caldwell, C., Kohn-Wood, L., & Zimmerman, M. (2003). Racial identity and academic attainment among African American adolescents. *Child Development, 74*, 1076–1090.

Elmesky, R. (2011). Rap as a roadway: Creating creolized forms of science in an era of cultural globalization. *Cultural Studies of Science Education, 6*, 49-76.

Elmesky, R., & Seiler, G. (2007). Movement expressiveness, solidarity and the (re)shaping of African American students' scientific identities. *Cultural Studies of Science Education, 2*, 73-103.

Emdin, C. (2010). Affiliation and alienation: Hip-hop, rap, and urban science education. *Journal of Curriculum Studies, 42,* 1-25.

Ezzy, D. (1998). Theorizing narrative identity: Symbolic interactionism and hermeneutics. *The Sociological Quarterly, 39*, 237-252.

Ferguson, A. (2000). *Bad boys: Public schools and the making of black masculinity*. Ann Arbor, MI: University of Michigan.

Finson, K.D. (2002). Drawing a scientist: What we do and do not know after fifty years of drawings. *School Science and Mathematics, 102*, 335-345.

Freire, P. (1994). *Pedagogy of hope: Reliving pedagogy of the oppressed*. New York: Continuum. (Original work published in 1992.)

Gee, J.P. (2002). Identity as an analytic lens for research in education. *Review of Research in Education, 25*, 99-125.

Harper, B. & Tuckman, B. (2006). Racial identity beliefs and academic achievement: Does being black hold students back? *Social Psychology of Education, 9*, 381-403.

Holland, D., Lachicotte, W., Skinner, D., & Cain, C. (1998). *Identity and agency in cultural worlds.* Cambridge, MA: Harvard University Press.

Jackson, K. (2009). The social construction of youth and mathematics: The case of a fifth-grade classroom. In D.B. Martin (Ed.), *Mathematics teaching, learning, and liberation in the lives of Black children* (pp. 175-199). New York: Routledge.

Johnson, A. (2012). Consequential validity and science identity research. In M. Varelas, (Ed.), *Identity construction and science education research: Learning, teaching, and being in multiple contexts* (pp. 173-188). Rotterdam, The Netherlands: Sense Publishers.

Kane, J.M. (2009). *Young African American children constructing identities in an urban integrated science-literacy classroom*. Unpublished doctoral dissertation. University of Illinois at Chicago.

Kane, J.M. (2012a). Young African American children constructing academic and disciplinary identities in an urban science classroom. *Science Education, 96*, 457-487.

Kane, J. M. (2012b). Multiple identities and the science self: How a young African American boy positions himself in multiple worlds. In M. Varelas, (Ed.), *Identity construction and science education research: Learning, teaching, and being in multiple contexts* (pp. 27-42). Rotterdam, The Netherlands: Sense Publishers.

Martin, D. (2000). *Mathematics success and failure among African American youth*. Mahwah, NJ: Lawrence Erlbaum Associates.

Martin, D. (2006). Mathematics learning and participation as racialized forms of experience: African American parents speak on the struggle for mathematics literacy. *Mathematical Thinking and Learning, 8*, 197-229.

Martin, D. (2007). Mathematics learning and participation in the African American context: The co-construction of identity in two intersecting realms of experience. In N. Nasir & P. Cobb (Eds.), *Diversity, Equity, and Access to Mathematical Ideas* (pp. 146-158). New York: Teachers College Press.

Martin, D. (2009). *Mathematics teaching, learning, and liberation in the lives of Black children.* London: Routledge.

Martin. D. (2012). Learning mathematics while Black. *The Journal of Educational Foundations, 26*(1-2), 47-66.

McGee, E., & Martin, D. (2011a). From the hood to being hooded: A case study of a Black male PhD. *Journal of African American Males, 2*(1), 46-65.

McGee, E., & Martin, D. (2011b). You would not believe what I have to go through to prove my intellectual value! Stereotype management among successful Black college mathematics and engineering students. *American Educational Research Journal, 48*, 1347-1389.

Olitsky, S. (2006). Structure, agency, and the development of students' identities as learners. *Cultural Studies of Science Education, 1*, 745-766.

Oyserman, D., Bybee, D., & Terry, K. (2006). Possible selves and academic outcomes: How and when possible selves impel action. *Journal of Personality and Social Psychology, 91,* 188-204.

Parsons, E.C. (2008). Learning contexts, Black cultural ethos, and the science achievement of African American students in an urban middle school. *Journal of Research in Science Teaching, 45*, 665-683.

Perry, T., Steele, C., & Hilliard, A. (2003). *Young gifted and black: Promoting high achievement among African-American students*. New York: Beacon Press.

Secada, W. (1992). Race, ethnicity, social class, language, and achievement in mathematics. In D. Grouws (Ed.), *Handbook of research in mathematics teaching and learning* (pp. 623-660). New York: Macmillan.

Seiler, G., & Elmesky, R. (2007). The role of communal practices in the generation of capital and emotional energy among urban African American students in science classrooms. *Teachers College Record, 109*, 391-419.

Sellers, R.M., Smith, M.A., Shelton, J.N., Rowley, S.A.J., & Chavous, T.M. (1998). Multidimensional model of racial identity: A reconceptualization of African American racial identity. *Personality and Social Psychology Review, 2*(1), 18-39.

Sfard, A. & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. *Educational Researcher, 34*, 14-22.

Spencer, J.A. (2009). Identity at the crossroads: Understanding the practices and forces that shape African American success and struggle in mathematics. In D.B. Martin (Ed.), *Mathematics teaching, learning, and liberation in the lives of Black children* (pp. 200-230). New York: Routledge.

Stinson, D. (2009). Negotiating sociocultural discourses: The counter-storytelling of academically and mathematically successful African American male students. In D.B. Martin (Ed.), *Mathematics teaching, learning, and liberation in the lives of Black children* (pp. 265-284). London: Routledge.

Strutchens, M.E., & Silver, E.A. (2000). NAEP findings regarding race/ethnicity: Students' performance, school experiences, and attitudes and beliefs. In E.A. Silver & P.A. Kenney (Eds.), *Results from the 7th mathematics assessment of the National Assessment of Educational Progress* (pp. 45-72). Reston, VA: National Council of Teachers of Mathematics.

Tan, E., & Barton, A.C. (2008). From peripheral to central, the story of Melanie's metamorphosis in an urban middle school science class. *Science Education, 92*, 567-590.

Tate, W.F. (1997). Race, ethnicity, SES, gender, and language proficiency trends in mathematics achievement: An update. *Journal for Research in Mathematics Education, 28*, 65-680.

Tobin, K., Elmesky, R., & Seiler, G. (Eds.) (2005). Improving urban science education: New roles for teachers, students, and researchers. Lanham, MD: Rowman and Littlefield.

Tucker-Raymond, E., Varelas, M., & Pappas, C.C. (2013). Children's conceptions of being scientists. In M. Varelas & C.C. Pappas, *Children's ways with science and literacy: Integrated multimodal enactments in urban elementary classrooms* (pp. 183-209). New York: Routledge.

Tucker-Raymond, E., Varelas, M., & Pappas, C.C. (with Korzh, A. & Wentland, A.). (2007). "They probably aren't named Rachel": Young children's emergent multimodal narratives of scientist identities. *Cultural Studies of Science Education, 1*, 559-592.

Tucker-Raymond, E., Varelas, M., Pappas, C. C., & Keblawe-Shamah, N. (2012). Young children's multimodal identity stories about being scientists. In M. Varelas (Ed.), *Identity construction and science education research: Learning, teaching, and being in multiple contexts* (pp. 77-93). Rotterdam, The Netherlands: Sense Publishers.

Vanneman, A., Hamilton, L., Baldwin Anderson, J., & Rahman, T. (2009). *Achievement Gaps: How Black and White students in public schools perform in mathematics and reading on the National Assessment of Educational Progress (NCES 2009-455)*. Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Varelas, M., Becker, J., Luster, B., & Wenzel, S. (2002). When genres meet: Inquiry into a sixth-grade urban science class. *Journal of Research in Science Teaching, 39*, 579-605.

Varelas, M., House, R., & Wenzel, S. (2005). Beginning teachers immersed into science: Scientist and science teacher identities. *Science Education, 89*, 492-516.

Varelas, M., Kane, J.M., & Wylie, C.D. (2011). Young African American children's representations of self, science, and school: Making sense of difference. *Science Education, 95*, 824-851.

Varelas, M., Kane, J.M., & Wylie, C.D. (2012). Young Black children and science: Chronotopes of narratives around their science journals. *Journal of Research in Science Teaching, 49,* 568-596.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. New York: Cambridge University Press.