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FORUM

Advancing alternate tools: why science education needs CRP and CRT

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Abstract Ridgeway and Yerrick's paper, *Whose banner are we waving?: exploring STEM partnerships for marginalized urban youth,* unearthed the tensions that existed between a local community "expert" and a group of students and their facilitator in an afterschool program. Those of us who work with youth who are traditionally marginalized, understand the importance of teaching in culturally relevant ways, but far too often—as Ridgeway and Yerrick shared—community partners have beliefs, motives, and ideologies that are incompatible to the program's mission and goals. Nevertheless, we often enter partnerships assuming that the other party understands the needs of the students or community; understands how in U.S. society White is normative while all others are deficient; and understands how to engage with students in culturally relevant ways. This forum addresses the underlying assumption, described in the Ridgeway and Yerrick article, that educators—despite their background and experiences—are able to teach in culturally relevant ways. Additionally, I assert based on the finding in the article that just as Ladson-Billings and Tate (Teach Coll Rec 97(1):47–68, 1995) asserted, race in the U.S. society, as a scholarly pursuit, was under theorized. The same is true of science education; race in science education is under theorized and the use of culturally relevant pedagogy and critical race theory as a pedagogical model and analytical tool, respectively, in science education is minimal. The increased use of both would impact our understanding of who does science, and how to broaden participation among people of color.

Keywords Science education · Culturally relevant pedagogy · Critical race theory · Urban science · Teacher preparation

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This forum speaks to the underlying tension that often exists between the mission and goals of programs designed to serve Black students and community partners, as described by Ridgeway and Yerrick in *whose banner are we waving?: exploring STEM partnerships for marginalized urban youth.* While Ridgeway and Yerrick were aware of the deficit orientation the community sponsors had about the students (Achievement Scholars) in their Achievement for All Program (AAP), there seemed to be an unspoken assumption that the local artist (Jacob) would understand how to actually engage the Achievement Scholars in culturally relevant ways. This tacit assumption is not limited to community partnerships, but it is also common within science education-particularly when the population of students being served is Black or are students of color. Building off this tacit assumption, I posit that the experience described by Ridgeway and Yerrick is not unique nor is it limited to afterschool programs. It is quite prevalent in formal school settings that are populated by predominantly students of color from families with low socio-economic status or within schools located in urban centers. I also assert, within this forum, that culturally relevant pedagogy (CRP), a pedagogical model, and critical race theory (CRT), an analytical tool, are under utilized in science education research. The use of both presents an opportunity to reconceptualize how students of color—particularly Black students—are positioned during the teaching and learning process and during research.

The broadening of participation of students of color in science has been a goal for quite some time. Across the United States (U.S.), informal science programs have been designed to provide students of color with opportunities to engage in science in ways that are more meaningful and engaging than what typically occurs in formal science classrooms. While many programs offer experiences that are drastically different from in-school science learning, which is often teacher-centered, others simply perpetuate the status quo. As Ridgeway and Yerrick experienced, their vision for the Achievement Scholars was to engage them in citizen science that not only provided learning experiences in science but also contained a community service component focused on art. However, the local art expert who was required by the community sponsor to assist with the mural creation portion of the program, did not know the Achievement Scholars and seemingly had no intentions or interest in getting to know them. Instead, Jacob arrived with his own agenda, motives, and beliefs about the students and unfortunately failed to fully engage the Achievement Scholars in authentic learning and in the meeting of their goal to create a community mural.

Within the Ridgeway and Yerrick's article, I noticed some assumptions, which were made by three key constituents in this experience that precipitated specific actions or behaviors. These key constituents, assumptions, and actions are outlined in Table 1.

Unfortunately for urban youth, and particularly students of color, deficit orientations toward their knowledge, skills, and experiences are prevalent. While Ridgeway and Yerrick were surprised by the deficit orientation of the community sponsors, I would argue that they should not have been. The widespread application of deficit perspectives is well documented within the extant literature. So much, in fact, that noted scholars such as have advanced methodologies and conducted research from an asset perspective with students of color. For instance, Sara Lawrence-Lightfoot and Jessica Davis (1997) advanced Portraiture methodology, which positions urban students as healthy and whole, while Gloria Ladson-Billings (1994/2009) set out to make Black students normative. If one views this deficit orientation through the lens of critical race theory (CRT), which occurs later in their article, again the deficit perspective becomes the norm as it is the reality espoused by those in power. I unpack the deficit orientation of the community sponsor and Jacob against CRT

Table 1 Constituent assumptions and actions

Constituents	Assumption	Action
Community sponsor	Deficit orientation toward the Achievement Scholars (e.g., Achievement Scholars lacked the knowledge and skills to engage in the mural project)	Required a local art expert to work with the AAP on the mural project
Jacob (local expert)	Deficit orientation toward the Achievement Scholars Relationship building would occur with little to no effort	Ignored the ideas that the Achievement Scholars generated on their own Expressed no interest in getting to know the Achievement Scholars Used coded language as a means to build relationships (Dixson and Dodo Seriki 2014)
Ridgeway and Yerrick	Achievement Scholars possessed an array of knowledge, skills, and interests that would be useful in the design and creation of the mural Jacob would want to get to know the Achievement Scholars Jacob knew how to engage students in culturally relevant ways Jacob understood culturally relevant pedagogy	Filled the gaps left by the local art expert (Jacob)

later in this forum. Presently, I want to examine Ridgeway and Yerrick's assumption that Jacob would know how to engage the Achievement Scholars in culturally relevant ways.

Culturally relevant pedagogy

Culturally relevant pedagogy is a pedagogical model developed by Ladson-Billings (1994/2009) and her work with teachers of African American students. Operating from an asset-based lens, she set out to not only determine what great teachers of African American students do but to also make Black students normative. Through her foundational work, which is predicated on critical theory and situated in anthropological studies, she identified three tenets upon which CRP is built. These three tenets include: Academic Achievement, Cultural Competence, and Socio-political Consciousness. Subsequent research of teacher candidates allowed Ladson-Billings (2001) to further explicate indicators of each tenet. These indicators and associated tenets are outlined in Table 2.

While CRP is an established model in multicultural education and within other content areas such as English Language Arts (ELA), it has yet to be widely used in science education (exception, Mensah 2011). Jacob's inability to engage the Achievement Scholars in culturally relevant ways is neither novel nor limited to non-education experts. In fact, CRP is often missing from teacher education programs (Fasching-Varner and Dodo Seriki 2012; Hayes and Juarez 2012) and in K-12 schools (Dixson and Dodo Seriki 2014). Thus, it is unreasonable to expect that Jacob, or any other community partner, could and would use CRP. In fact, I suspect that his own schooling experiences along with his deficit orientation toward the Achievement Scholars were contributing factors to his approach to interacting and teaching *at* the students. Jacob's use of menial busy work is akin, as Ridgeway and Yerrick noted, to the daily school experience of the Achievement Scholars and other students of color.

Table 2 Tenets and indictors of culturally relevant pedagogy

Tenet	Indicators
Academic achievement	The teacher presumes that all students are capable of being educated
	The teacher clearly delineates what achievement means in the context of his or her classroom
	The teacher knows the content, the learner, and how to teach content to the learner
	The teacher supports a critical consciousness toward the curriculum
	The teacher encourages academic achievement as a complex conception not amenable to a single, static measurement
Cultural competence	The teacher understands culture and its role in education
	The teacher takes responsibility for learning about students' culture and community
	The teacher uses student culture as a basis for learning
	The teacher promotes a flexible use of students' local and global culture
Sociopolitical consciousness	The teacher knows the larger sociopolitical context of the school community, nation, and world
	The teacher has an investment in the public good
	The teacher plans and implements academic experiences that connect students to the larger social context
	The teacher believes that students' success has consequences for his or her own quality of life

Critical race theory

Critical race theory (CRT), which is rooted in Critical Legal Studies (Ladson-Billings 1999), was advanced in educational research by Ladson-Billings and Tate (1995). They sought to provide a tool that would be useful in theorizing about race in education. Borrowing tenets from CRT, CRT in education is built around eight major constructs that allow for the examination of race, racism, power and privilege in education. These eight constructs are outlined and described in Table 3 along with citations of the scholar most closely associated with that construct.

Ridgeway and Yerrick's use of CRT was both appropriate and timely. As Ladson-Billings and Tate (1995) asserted race is under theorized in education and the same is true of science education today. By using CRT as an analytical tool, they explicitly show how Whiteness as Property and racial realism—although not explicitly identified by those labels by the authors—functioned to subjugate the Achievement Scholars by both Jacob and the community sponsor. In addition, both the contribution of the community sponsor and Jacob highlights interest-convergence, and the retelling of the Achievement Scholars' story gives them voice and allows them to name their reality (Delgado 1989).

Interest convergence as posited by Bell (1980) explains how the interest of people of color are met when those interest coincide with the interest of Whites. Bell used the 1954 Supreme Court Case, *Brown versus the Board of Education Topeka Kansas*, to explain an illustrate how interest convergence was manifested. While interest convergence is not readily obvious between the Achievement Scholars and Jacob, this symbiotic relationship functioned behind the scenes between the community sponsor and the AAP afterschool STEM program. The program, as with most community-based programs, required funding

Table 3 Critical race theory constructs, descriptions and scholars

CRT constructs	Description	Scholar(s)
1. Racial realism	Racism is an ordinary part of American Society. Thus fighting for social justice involves exposing it (Ladson-Billings 1999)	Bell (1992a, b)
2. Voice/counterstory	Voice/counterstory allows the subordinate to name their reality. It is a way to interject the cultural viewpoints of those on the receiving end of racism	Delgado (1989)
3. Critique of liberalism and colorblindness 4. Restrictive versus expansive view of equality	This critique offers a skeptical examination of the liberal perspective of slow yet steady progress toward social change through legal precedence, and the claims of neutrality, objectivity and meritocracy	Crenshaw (1988)
5. Interest-convergence (also termed material determinism)	Interest convergence is akin to the symbiotic relationship of mutualism. It explains how the interest of people of color is met when those interests convergence with those of Whites	Bell (1980)
6. Whiteness as property	Harris (1993) describes the way in which Whiteness functions as property that must be protected. Her assertion included the following four points: Right to disposition; Right to use and enjoy; Reputation and status property; and Absolute right to exclude (Ladson-Billings and Tate 1995, pp. 55–59)	Harris (1993)
7. Social change	Social change, as the phrase denotes, is working toward ending or eliminating racial oppression, and Decuir and Dixson (2004) suggest this be done by "… uncover[ing] and unmask[ing]… the normativity of Whiteness" (p. 30)	
8. Intersectionality	This construct of CRT acknowledges that there are other social phenomena (e.g., gender and social class) that compound the layers of oppression when they intersect with race	Crenshaw (1989)

through a sponsor, and the community sponsor gained some benefits—even if it was only status within the community. Jacob certainly benefited from his collaboration with the AAP afterschool STEM program, but the Achievement Scholars and the program gained very little if anything from his sporadic participation and aloofness toward working with the students.

Voice, another construct of CRT, was prevalent throughout the Ridgeway and Yerrick's article. It was extremely valuable and powerful to hear the words of the Achievement Scholars as they persevered through Jacob's presence, absences, and obliviousness to their needs. Anyone who reads their experiences, would find Jacob's actions unconscionable at best and abhorrent at worst. As Ridgeway and Yerrick assert, the experience of the Achievement Scholars is not unique, but what is novel to science education is the use of CRT to analyze the experience and to problematize the issue of race and power (via positioning) between the community-based program and the local expert partnership.

Where and how does CRP and CRT fit in science education?

Since Eileen Parsons, Billye Rhodes, and Corliss Brown's (2011) explication of the origin, evolution and minimal use of CRT in science education, very little has changed in relation to the use of it and CRP in science education. A cursory search of articles and forums in this journal using the following keywords, Culturally Relevant or CRP, yielded 45 publications. A similar search for Critical Race Theory, or CRT, within this journal produced six publications. Therefore, while both have been used as a model in science education research, there remains significant work for science educators and science teacher educators to do with Critical Race Theory. There remains a need for more CRP as an approach to engaging all students in science teaching and learning, and the use of CRT to examine race, racism, and power in science education.

Culturally relevant pedagogy in science education

Culturally relevant pedagogy fits in science education as a promising pedagogical approach that engages all students—not just a few elites. As I reflect on the ways in which I have seen teachers attempt to enact CRP, I am moved to offer two suggestions for those wishing to engage in it. The first suggestion is for educators to engage in what Tyrone Howard (2003) calls critical self-reflection, or what Felicia Mensah (2009) promotes critical reflective inquiry. In both cases, this type of self-reflection stimulates thinking about one's own experiences with race, power, and privilege and how those translate into practices within the classrooms or other learning spaces. For Jacob, this critical self-reflection did not occur while he partnered with the AAP. This was evident in his perpetual absences, and in the way he structured his teaching.

Secondly, those wishing to engage CRP must understand that it is dispositional in nature. In 2006, Ladson-Billings encouraged educators to shift their focus from ways of doing (discrete steps) to ways of being (disposition). An educator cannot hold a deficit-orientation toward students while engaging CRP. Those who do so often relegate CRP to a set of strategies or steps, which Ladson-Billings (2012) has already debunked. For those possessing a deficit-orientation who do not relegate CRP to mere strategies, they either consciously or unconsciously refuse to engage CRP at all. Often claiming that CRP is best used with specific populations (i.e., students of color) or contexts (i.e., urban schools). However, Ladson-Billings' (2012) intent was not to create a pedagogy for specific populations, but she endeavored to make Black students normative while developing a model that meets the needs of all students.

Critical race theory in science education

Given the limited use of CRT as an analytical tool in science education, I strongly recommend that scholars take up the use of it. I think it provides a strong way to give voice and agency to students who are traditionally underrepresented in or marginalized by Western science (Aikenhead 1996). In addition to giving voice, the use of CRT would help illuminate and perhaps eradicate practices within science classrooms that perpetuate the status quo by subjugating the voices, experiences, and knowledge of students of color. The under utilization of CRP as a pedagogical model and CRT as analytical tool is the current status quo for science education, and as previously mentioned has been since Parsons, Rhodes, Brown (2011) recommended for its increased use in science education. Science

educators must continue to advance CRP and encourage the use of CRT if broadening participation is indeed a goal for science.

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