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Da Math Ain't Mathin': A Research Commentary of Black Students' Language Use in Mathematics Education

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Abstract

Foundational principles of formal math language in mathematics classrooms are necessary for students' ability to succeed academically. However, cultural dialects such as Black language are vilified within the scope of education, particularly in mathematics education, despite evidence that acknowledging students' cultural and linguistic backgrounds aids in their understanding of mathematical concepts. In a sociopolitical context that does not support the use of culture as it relates to race and gender, educators face even more challenges in pursuit of linguistic and cultural justice. We provide commentary on Black students' language use to facilitate critical conversations regarding mathematics teaching, learning, and culture and its implications for Black students. To this end, we provide recommendations for stakeholders in mathematics education that can provide a starting point to make mathematics education a more welcoming discipline.

Keywords: mathematics, culturally responsive teaching, linguistic justice, urban education

Introduction

As education researchers, we hold both individual and collective responsibility to act in creative resistance to disrupt detrimental educational practices and ideologies while continuing to promote practices that cultivate brilliance and excellence. Although there is a persistent narrative that the STEM (science, technology, engineering, and mathematics) fields are objective and unrelated to race or cultural issues (Ladson-Billings, 2021), when juxtaposed with the lived experiences of Black and Brown students, as well as math education federal policy documents, this narrative needs to be reexamined (Berry III, 2021; Ernest, 2019; Madkins & Morton, 2021; Muhammad et al., 2021). Furthermore, within the last five years the attack on critical race theory has found its footing in K-12 education, and mathematics is not without reprieve.

The sociopolitical context of schooling poses a particular challenge to the shaping of curriculum along racial lines. In 2022, the Florida Department of Education rejected 54 mathematics textbooks, citing that these texts promoted social-emotional learning and critical race theory (Goldstein & Saul, 2022; Najarro, 2022). This occurrence is not unique to Florida, as 41 other states have introduced bills that limit discussions of race, class, and gender in their schools. These laws seek to create a learning environment of censure and erasure by banning the recognition of non-white, non-male mathematicians and ignoring the value of the cultural backgrounds of students in mathematics classrooms and withholding the positive benefits of cultural integration in mathematics classrooms (Abdulrahim & Orosco, 2020). Thus, the gross disenfranchisement of culturally responsive mathematics teaching warrants a further discussion of the discourse disconnect that censorship and erasure create in austere learning environments.

Additionally, a teacher workforce that is overwhelmingly white provides challenges in making cultural and linguistic connections with Black and Brown students that Black and Brown teachers do not often struggle with (Milner, 2006). This cultural mismatch can cloud educators' ability to see the value in students' language use outside the scope of bi- and multilingualism. In the fall of 2019, approximately 5.1 million K-12 students in the US were classified as English Language Learners (NSES, 2022), a number that excludes students whose first language is "non-standard" English, such as Black English. Incorporating students' cultural backgrounds and first languages in the mathematics classroom offers an opportunity to support students' learning and identities

through an asset-based approach (Abdulrahim & Orosco, 2020; Gutiérrez, 2002; Morales & DiNapoli, 2018). To this end, we seek to facilitate critical conversations regarding mathematics teaching, learning, and culture and offer a discussion of methods empowering Black students' use of language while deviating from white, heteronormative language standards of mathematics education. Grounding this commentary in Black Feminist Thought, we provide recommendations for mathematics education stakeholders to implement in their districts, schools, and classrooms.

Theoretical Framework

By grounding this work in Black Feminist Thought, we can examine how Black students are impacted by language discrimination in mathematics classrooms at the intersections of race, class, and gender. Hill Collins (1990) asserts that "one distinguishing feature of Black feminist thought is its insistence that both the changed consciousness of individuals and the social transformation of political and economic institutions constitute essential ingredients for social change" (p. 413). For mathematics educators to support systematically minoritized student groups' learning and educational experiences, they must understand and recognize the cultural relevance of first language. The districts and schools servicing these students must also address the anti-blackness in mathematics instruction regarding language use. This shift occurs through a change of consciousness relating to Black English in classrooms. It is an unfair assertion that students must understand mathematics language while holding onto the idea that students' first language is inferior.

Mathematics Education and Language

The Commission of Mathematics and Science Education (2009) and the National Council of Teaching Mathematics (2000) identify mathematical knowledge as a key aspect of citizenship in our democracy. Thus, we have awarded the discipline a position of immense importance and subsequent power. The language of mathematics is not only foundational to science, technology, and engineering (Ernest, 2019) but also to the social, political, and economic fabric of our lives (Ladson-Billings, 2021). Researchers such as Aguirre et al. (2017) highlight the endemic issue of equitable experiences of students of racial, ethnic, and language backgrounds that differ from white students of the dominant culture and call for anti-opressive, socially just

advancements in mathematics education. However, although there are legislative pushes for fluency and understanding of traditional mathematical language as fundamental for academic and social mobility, there is not a similar systemic push for educators to understand culturally relevant dialects such as Black Language.

Students' proficiency in mathematics is characterized by factors such as conceptual understanding and fluency, procedural and problem solving skills, as well as language use (NCTM, 2001; Riccomini et al., 2008). Students' mathematical languaging ability is derived from their ability to communicate mathematically through explanations and justifications and their ability to examine claims and make use of definitions (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010; Riccomini et al., 2015). Research on mathematics discourse draws on approaches to language and discourse such as the functional perspective. Under this approach, researchers view lexical and synthetical attributes as mechanisms for communicating and learning (Erath et al., 2021; Schleppegrell, 2007; Snow & Uccelli, 2009). As such, the language of mathematics poses unique challenges that warrant consideration of educators (Table 1).

Table 1

Considerations for Mathematics Vocabulary; adapted from Rubenstein & Thompson (2002)

Consideration	Example
The meaning of words in mathematics is context dependent.	"The *mean* score is 75." and "I didn't *mean* to sleep in this morning."
There is greater precision in the meaning of mathematical words.	"The two triangles are *similar* since their corresponding angles are congruent and they have equal ratios of their side lengths." and "Rose and Rachelle wore *similar* shoes to school."
There are words unique to mathematics.	Abscissa, apothem, monomial
There are multiple meanings of mathematical words.	"The *base* of a logarithmic function" and "The *base* of a rectangular prism."
There are discipline specific, technical meanings of mathematical words.	*integration* in calculus and *systems integration* in engineering
There are mathematical words with homophones to everyday words.	*sin* and *sign*
There are related but unique mathematical words.	vector and array, perimeter and circumference
There are a variety of ways to describe concepts.	*skip counting* versus *multiples*, *multiplicity* and the *number of factors*
There are informal dialects to describe concepts, developed by both students and teachers.	"Feed both kids in the house" to describe distributing by multiplying both terms inside of the parenthesis $a(b + c) = ab + ac$

While language-based research in mathematics is a heavily investigated strand of inquiry, it has a particular focus on English Language Learners (Barwell, 2018). While first-language integration affects all students in classrooms, this has particular implications for Black and Brown students whose cultural dialects are often judged and seen as inferior to the mainstream "standard" English (Baker-Bell, 2019; Ladson-Billings, 2000). A prominent example of the deficit narratives surrounding Black language and languaging in mathematics education is the work of Eleanor Orr (1997) (Ortiz & Ruwe, 2021; Ortiz, 2022). For instance, Orr's (1997) analysis of Black students' discourse surrounding Euclidean geometry tasks provides examples of discursive patterns in mathematics that vary from the Standard American English (e.g. algebraic equations and

comparisons). Although Orr (1997) elucidates the mathematical mastery and creativity of the Black students, her depiction of Black language as an impediment that students must overcome to further develop their mastery through the Standard American English means of expression is problematic. Moreover, the approaches to race in extant mathematics education research, policy, and practice conceptualize learners in a racial hierarchy of mathematical ability with a gross dichotomy of those who can/cannot do mathematics and those who are/are not mathematically literate (Gholston & Martin, 2019; Martin, 2009). Research in bilingual education highlights the past prohibition of code-switching and associated deficit stigma used in students' mathematics discussions (Moschkovich, 2005) and the opportunities to frame mathematics learning within a linguistically rich environment where students are not constrained to one modality.

Historically, Black people have used mathematics in ways that affirmed and uplifted their communities. Ida B. Wells-Barnett evidenced this in her tabulations of lynching statistics against Black people in the South in *The Red Record*. Similarly, names such as Benjamin Bannaker, Kelly Miller, and W.E.B. Du Bois ring in the mathematics traditions, proving that Black Language has its bearings in mathematics and mathematics education (Alexander, 2022). Furthermore, Martin (2007) asserts that students' mathematics identity relies on the articulation of their abilities and performances of mathematical tasks. Ortiz (2022) expands Martin's (2007) argument by necessitating the critical examination of language and mathematics due to the interwoven nature of mathematics and identity construction in combination with Black students' use of language as a means to "confront stereotypes, to assert their brilliance, and to perhaps more importantly, demonstrate their explanations and ideas related to specific mathematics concepts" (p. 6). Thus, affirming students' linguistic and mathematical identities is situated within the sociocultural perspective of student-centered negotiation of knowledge and meaning-making as providing a between understanding of the connection between the mathematics language and Black Language moves toward a more welcoming learning environment for Black students and recognition of Black students' mathematical understanding.

Black Language

Black Language has roots in West African Languages. At the inception of slavery in the United States, Black Language grew out of enslaved Africans who needed to be able to communicate with each other

(Smitherman, 1983; 1997). Since then, Black language has grown to be a pivotal cornerstone for Black students and adults within society. There is absolutely no way for schools to claim to be culturally responsive when these students are constantly silenced and banned from using their native language in academic settings. Language has been a driving factor in classroom experiences for many marginalized groups. Current scholarship shows that Black students have racialized experiences in mathematics classrooms (Butler-Barnes et al., 2021). In turn, Black students experience language discrimination within their school communities that permeates into their mathematics classrooms. Flores & Rosa (2015) stated that raciolinguistic ideologies could have detrimental effects on students who speak languages or dialects outside of standard academic English. By limiting the use of Black language in schools, Black students are denied the opportunity to blend their L1 and L2 languages towards a holistic approach to language planning and learning (Duran & Palmer, 2014). This ultimately upholds a cycle of anti-Blackness within mathematics classrooms. Unfortunately, this dismisses the many benefits of Black language usage in mathematics education.

Nasir & de Royson (2013) found that mathematics learning takes place in African American Discursive style, which utilizes cultural elements such as call and response and clever quips. Similarly, O'Connor (1999) identified the relationship between students outside of school experiences and how they provide students with opportunities to build their knowledge of mathematical concepts. However, Battey and Neal (2018) found evidence of this type of mathematical discourse going unrecognized by math educators in classrooms. Although cultural elements of Black students and their language are shown to be particularly helpful to their education, there is still an apparent disconnect between mathematics education and Black language use.

Martin (2019) postulates that anti-Blackness is ubiquitous and requires change on an individual and collective level (p. 462) and that contemporary studies make deficit claims that Black children enter K-12 schooling with limited mathematical knowledge and little ability to translate their experiences to traditional mathematical language and abstract representations. Additionally, Martin (2004, 2007) found that racialized experiences in mathematics education often push Black students away from the discipline. He further elucidates that although the literature questions the mathematical capabilities of the incoming Black students, there is no question as to if traditional abstraction is the best fit for mathematizing the students' lived experiences where

they engage mathematically outside of the classroom. To this end, the literature must move toward mathematics education that acknowledges and affirms the cultural underpinnings of Black language within the mathematics classroom.

Discussion and Recommendations

Culturally responsive teaching aims to be asset-based, supports and challenges students, utilizes student-centered learning, leverages students' linguistic & cultural backgrounds, and unites students' schools, families, and communities (Ladson-Billings, 2000). In order for mathematics education to move into a more inclusive space, they must acknowledge the cultural elements that students bring to the classroom and begin leveraging the linguistic backgrounds of students. This requires that mathematics educators begin to shift their thinking and recognize the value of providing space for using Black Language in their daily lessons. Table 2 includes recommendations that mathematics education programs, educators, and administrators can use to improve the relationship between Black language and mathematics education.

Table 2
Recommendations for Practice

Recommendation	Explanation
Exposure to a broader range of multilingual discourse	Educator Preparation Programs (EPP) must examine the discourse of linguistically diverse student groups outside of bilingual/ ESL education. By limiting the conversation to English language learners, EPPs miss a unique opportunity to engage their student teachers in critical conversations about language use.
Focus on teacher noticing	EPPs should equip student teachers with the skills to recognize students' use of mathematical language in a variety of speech and language patterns. Teacher listening and noticing are critical and valuable to the use of language in mathematics classrooms.
Focus on linguistic connections	Mathematics educators should also pay particular attention to student development of language proficiency, multiple meanings, and transferability of knowledge within their lessons and connections.

Contextualization of mathematics teaching & learning	Contextualization of mathematics (CoM) is a promising vehicle for providing critical consciousness and ideological clarity for mathematics educators through rectifying and elaborating systems of power (Rubel & McCloskey, 2021). Mathematics educators can use CoM as a method to guide their curriculum building and lesson planning to ensure that students' cultural and linguistic backgrounds are reflected in work being done.
Reimagining discourse structure in the mathematics classroom	Mathematics education should raise the question of what mathematical language is already in use and how they can reimagine the mathematics classroom by disrupting the didactic contract through student-centered discourse.

While this list is not exhaustive, it does present a starting point for mathematics education stakeholders to consider as they work to reverse the anti-Blackness in mathematics education. Future research should be conducted to examine the impact of the use of Black English and other culturally relevant dialects within mathematics on students' conceptual understandings, co-construction of knowledge, and student-teacher relational discourse. Additionally, an analysis of Mathematics EPP programs should be conducted to examine what elements of culturally responsive teaching and language learning are represented in their degree programs as a solution to alleviate current issues of language in mathematics education.

Conclusion

Ortiz (2022) asserts that "mathematics education must begin to honor the ways the Black Children use language and engage in distinct linguistic patterns in unique and culturally affirming way" (p. 6-7). Black language and other cultural dialects have a right to be acknowledged in educational spaces as meaningful ways to communicate knowledge. The campaign of "anti-woke" legislature across the US threatens to perpetuate anti-Blackness and exclusionary curriculum and instruction in schools across the country regardless of the associated consequences. Thus, bolstering efforts to support systemically marginalized students through culturally relevant pedagogy is urgently of the essence. Although individual educators may practice creative resistance to such

policies within their classrooms, and EPPs with more academic freedom may continue to cultivate communities that foster equitable practices, a transformation of political institutions must occur to catalyze systemic change (Hill Collins, 1990). It is only with widespread change that actual change can occur in the education of Black students. Within the scope of mathematics education, this can be the change that begins to change the trajectory of Black students in mathematics education through affirming their cultural and linguistic identities. Through fostering multilingual learning environments, mathematics education becomes a more accessible form of knowledge to systemically marginalized groups.

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