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Restoring Mathematics Identities of Black Learners: A Curricular Approach

Black learners are subject to systemic physical, symbolic, and epistemological violence in mathematics classrooms. Such violence has negative ramifications for Black children's mathematics learning and identity development. The authors argue that space should be made within the mathematics classroom to repair the harm caused by this violence. This article describes an identity-based curriculum,

Mathematics for Justice, Identity, and meta-Cognition (or MaJIC), that provides a form of mathematics therapy through a restorative justice framework. The Silhouette Activity is highlighted as one approach that allows Black mathematics learners to engage in a restorative process of writing and drawing the internal and external messages they receive as mathematics doers and knowers.

Introduction

Mathematics education has been, and continues to be, a site for the production and reproduction of racialized inequities that

constrain the educational opportunities of Black students (Martin, 2013). Recent scholarship has increased our awareness of this by shedding light on the ways these inequities interfere with Black students development of identities as mathematics learners and doers (Larnell, 2011; McGee & Martin, 2011; Nasir & Shah, 2011). One avenue of contending with these inequities has been the adoption of psychological interventions such as grit (Duckworth, 2016) and growth mindset (Dweck, 2006) as a means of helping Black students exhibit resilience and persevere through the challenges they encounter during their mathematics education. Echoing McGee and Stovall (2015), we believe that such interventions fail to account for the racialized nature

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of students experiences with mathematics and the toll that contending with the various forms of harm enacts on Black learners. To address this failure, we too advocate for interventions that go beyond helping students to cope with the violence endemic to their mathematics learning to promote radical healing (Ginwright, 2010).

In this article we report on the design and implementation of a curricular intervention that seeks to restore the relationship between Black learners and mathematics. Mathematics for Justice, Identity, and meta-Cognition (*MaJIC*) is an identity-based curriculum designed by the first author and implemented in a college bridge program for underrepresented minorities. The curriculum takes up a restorative frame for mathematics through lessons and activities premised on a positive developmental theory of Black mathematics learners. Here we highlight one activity in the *MaJIC* curriculum, the Silhouette Activity, as a form of mathematics therapy that embodies the restorative process to support mathematical identity development and repair. To begin, we rely on restorative process questions to highlight the need for such curricular interventions. Next, we articulate the foundations of the *MaJIC* curriculum and report on its implementation. Finally, we turn to the Silhouette Activity to demonstrate the restorative capacity of the curricular intervention.

The Restorative Process

Restorative justice is the resolution of conflict between individuals when harm has been suffered at the figurative – and often literal – hands of another. Interpersonal reconciliation is a primary focus of restorative justice seekers, as is the reparation of injuries caused by the dispute (Zehr & Mika, 2003). The restorative process seeks these outcomes by inviting and facilitating the active participation of the victimized, the offenders, and their communities (Braithwaite, 2002; Zehr, 2014). Restorative processes are

often initiated through a series of questions: What happened? Who has been affected by what has been done? In what ways have they been affected? What needs to happen to make it right? Typically, the restorative process seeks these outcomes by inviting and facilitating the active participation of the persons involved with the conflict but what seems appropriate when the offender is a disembodied, disciplinary community? What might restorative justice look like when the offending party is the system of mathematics education responsible for decades of systemic violence, neglect, and intrapsychic injury to Black learners? In the following sections, we contend with these restorative questions as a way to illustrate the need for a restorative project in mathematics education.

What Happened? Who Has Been Affected by What Has Been Done? In What Ways Have They Been Affected?

Over the last few years, popular media has surfaced numerous examples of the harm inflicted upon communities of Black students within their mathematics classrooms. This harm includes violent classroom events and denigrating word problems within mathematics curriculum. For example, A 2016 *New York Times* article chronicled the fallout after a video surfaced of a teacher ripping a Black first grade student's work in half, sending her to a corner, and berating her for "confusing everyone" (Taylor, 2016). In another widely publicized video, a school resource officer throws a young Black girl from her desk after she allegedly refused to put her phone away during math class, highlighting how larger societal contexts and the contours of mathematics education sometimes converge in ways that result in physical harm (Gholson & Wilkes, 2017). Williams (2013) and Judge (2017) both report on instances where the painful legacy of slavery was invoked as context for word problems in elementary school mathematics courses. These problems asked students to perform calculations in

contexts involving the use of slaves to pick a field of cotton, the number of whips a set of slaves accumulated over time, and the death of slaves on a slave ship. In another instance, a high school mathematics teacher invoked racial stereotypes about the imagined criminality, hypersexuality, and social deviance of Blacks as a context for mathematics. Folley (2016) reports that this teacher assigned a widely circulated quiz with word problems that referenced characters with stereotypical Black names (e.g. Tyrone and Leroy) involved in gangbanging, pimping, and gun violence. Numerous curricular materials invoke the painful legacy of slavery or perpetuate disturbing racial stereotypes such as the imagined criminality and social deviance of Blacks (Judge, 2017; Williams, 2013).

While such incidents are written off as atypical occurrences, a rigorous review of the physical, symbolic, and epistemological violence endured by Black learners in US contexts (Martin, Price, & Moore, 2018) suggests that they are characteristic of Black learners' experiences in mathematics classrooms. These forms of violence at the classroom level are enabled and perpetuated through various systemic inequities. For example, Black learners are disproportionately tracked into lower-level mathematics courses (Battey, 2013; Oakes, 1990), are excluded from considerations for advanced mathematics courses (Berry, 2008; Faulkner, Stiff, Marshall, Nietfeld, & Crossland, 2014), and are persistently exposed to sub-par mathematics teaching (Davis & Martin, 2008). The cumulative effects of living within these structures constrain Black learners' opportunities to participate and excel in mathematics.

One clear casualty of the systemic violence in mathematics education is the interference with the development of positive, robust mathematics identities for Black students (McGee, 2015). A mathematics identity is "the dispositions and deeply held beliefs that students develop about their ability to participate and perform effectively in mathematical contexts and to use mathematics in powerful ways across the contexts of their lives" (Aguirre, Mayfield-Ingram, & Martin, 2013). Many students' desire to engage in mathematics

as a discipline and their efficacy using the subject in meaningful ways erodes over the course of their academic lives, culminating in low participation rates and disinterest in high school and post-secondary mathematics (Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Linver & Davis-Kean, 2005). Such patterns are particularly concerning because mathematics mediates access to social, academic, and economic opportunities (Moses & Cobb, 2001; Stinson, 2004; Tate, 2005). Some students are cognizant of the structures and conditions (e.g., Larnell, 2016) that constrain their opportunities to excel in mathematics, whereas other students begin to associate their value and worth as mathematics learners with the conditions in which they are learning. Perhaps the most unfortunate outcome of these conditions is not racialized achievement gaps in mathematics, but Black children's subconscious association of their own Blackness with mathematical inferiority.

Given Black children's exposure to harm within mathematics classrooms and the deleterious effects of this harm on the development of a positive mathematics identity, we propose an identity-based program that seeks to restore and reconcile Black students to this gatekeeping discipline (Moses & Cobb, 2001; Stinson, 2004). Turning to the restorative process question "what needs to happen to make it right?", we advocate a form of mathematics therapy for students that attends to the racialized and gendered complexities of mathematics learning.

What Needs to Happen to Make It Right? One Curricular Approach

While mathematics is often seen as "a great intellectual product of human culture" with valuable social applications (Ernest, 2018, *p.* 189), the beauty, history, and utility of mathematics is too often obscured by school contexts in which math is used to construct racial hierarchies of intelligence (Martin, 2013) and distribute social opportunity (Oakes, 1990; Stinson, 2004). These contexts disproportionately exact harm on Black learners and interfere with their opportunities to

learn and develop a positive mathematics identity. Efforts to rehabilitate mathematics perceptions and children's learning experiences have focused primarily, if not exclusively, on content learning. The major thrust of these efforts has been redefining and increasing access to high quality mathematics instruction in service of ameliorating racial disparities in achievement (Gutiérrez, 2008). Remedial courses seek to address inadequate instruction and inquiry- and project-based learning have emerged as curricular frames to make mathematics classrooms more dynamic, more productive, and more positive (Flores, Phelps, & Jansen, 2017; Hassi & Laursen, 2015). However, such efforts fail to address the racialized nature of students' experiences with mathematics (Martin, 2003) and the relational harms. Fueled by this critique, our conception of restorative justice in mathematics focuses on the restoration and reconciliation of children's mathematics identities. The restorative approach we have taken privileges the interrogation of the human experience with mathematics, i.e., mathematics as humanities, and intentionally backgrounds that which has always come first in the study of mathematics—its techniques for solving well-structured problems.

Typically, the restorative process seeks repair and reconciliation by inviting and facilitating the active participation of the victimized, the offenders, and their communities (Braithwaite, 2002; Zehr, 2014). Mathematics is unavailable to account for the harm it has caused because of the distributed and disembodied forms through which mathematics impacts people's lives. Yet despite the lack of an accountable offender, restorative justice advocates note the benefits of even "partially restorative processes" (McCold & Wachtel, 2002). Indeed, restorative justice programs have been developed to help victims process their experiences by answering questions that pursue four types of needs: information seeking, truth-telling, empowerment, and restitution or vindication (Zehr, 2014). What might a such a program look like in mathematics education? As an example, the following sections introduce a curriculum that takes up a restorative frame for mathematics through lessons and activities

premised on a positive developmental theory of Black mathematics learners.

Theoretical Foundations of the MaJIC Curriculum

Mathematics for Justice, Identity, and meta-Cognition (*MaJIC*) was designed by the first author, who also wrote and led the writing of lesson activities and curriculum guide. *MaJIC* was implemented as a part of a college bridge program supporting predominantly Black students in the southeastern Michigan in 2016 as a form of mathematics therapy for the inaugural cohort. The theoretical foundations of the *MaJIC* curriculum are based on a meta-analysis of qualitative studies focused on Black mathematics learners negotiating multiple contexts (Berry & Thunder, 2012). According to Berry and Thunder, the perseverance and success of Black mathematics learners is a cyclical process of decision-making and self-evaluation based on racialized forms and images, coupled with sustained work ethic. The following foundational ideas ground the identity-focused MaJIC curriculum: Black learners require opportunities for (1) active exploration of self as a mathematics learner in various contexts to develop criteria for success in mathematics, (2) cultivation of agency and identification of key decision points that lead to different pathways, and (3) construction of a mosaic of images to measure success and navigate pathways.

MaJIC Curriculum Objectives, Lesson Types, and Lesson Content

The abovementioned foundational ideas were operationalized into three curricular objectives. The first relates to socializing learners toward authentic and meaningful ways of doing and knowing mathematics, which is a departure from traditional practices of rote memorization, recall, and answer-getting. The second curricular objective attends to learners' personal goals and focuses on the development of mathematics-specific study skills. The third expands the utility of mathematics beyond personal self-interest, cultivating learners' sense of social responsibility and political agency

at local, national, and global levels. The *MaJIC* curriculum thereby shifts students' conceptions of mathematics to reflect their own needs as learners, as well as the needs of their communities. The *MaJIC* curriculum instructional guide states,

[T]he conceptual framework for the program seeks to provide scholars with rigorous, engaging mathematical content as a means to foster more positive attitudes and perceptions about the discipline of mathematics. This means engaging students in rich content with high cognitive demand that provides opportunities to exercise agency, voice, and authority in mathematics activity. ... Empowering students to see themselves as competent doers of mathematics is essential for gaining admittance into competitive colleges that demand advanced mathematics course-taking, which requires mathematical skill and fluency, but also perseverance and resilience. For children of color, this also means acknowledging that improvement within the discipline requires effective navigation of prejudice, discrimination, and racism within and outside of the mathematics classroom. (p. 2)

Aligned with these objectives, the curriculum features 3 lesson types: using mathematics for justice, developing positive mathematics identity, and developing mathematics-specific meta-cognitive skills (see Figure 1).

Each lesson is designed to cultivate learners' positive relationships to mathematics by transforming patterns of interactions between students, teachers, and mathematical content. The social justice-oriented lessons explore worker compensation in the US and include in-depth interrogation of

the minimum wage and opportunities for learners to explore how different kinds of work are valued, as well as the extent to which compensation aligns with cost of living. These lessons are modeled after Gutstein's (2016) conceptual framework *reading and writing the world with mathematics*, which is based on Freirean principles and "encompasses an epistemology of learning by doing, but the doing has the explicitly political intent of transforming society towards equity and justice" (p. 455).

Seeing mathematics as a tool for justice suggests that learners can imagine themselves as able and willing to wield mathematics. The identity lessons provide opportunities for such learners to explore their relationships with mathematics by explicitly narrating, drawing, and discussing their classroom experiences. While processing experiences of harm can provide some relief, learners also need everyday practices for managing mathematical work and feelings associated with the relational demands of mathematical work. The meta-cognition lessons are designed to help students regulate and organize their thinking, and manage their learning environments (in school and/or where they do homework). Together, these approachable lessons facilitate learning experiences that have the potential to repair images of mathematics and mathematics doers, while restoring harmony between learners and the discipline of mathematics.

The Work of Mathematical Restoration and Reconciliation

Implemented in a college bridge program associated with a large public university, the

Mathematics for Justice	Identity	Practices & Metacognition
Understanding the connection to wages and expenses	Connection between self, math, and community	Understanding meta-cognition
Using slope to explore rate of pay	Identifying the relationship to math	Developing space to do homework
Investigating minimum wage	Debunking myths about being a math person	Strands of mathematical proficiency
From the individual to the community		Understanding making mistakes
		Making the most of homework

Figure 1. MaJIC curriculum lessons types and lesson themes.

MaJIC curriculum was developed to increase the university’s pipeline of underrepresented minorities. After attending seasonal sessions every year from 7th to 12th grade to complete the program, participating students admitted to the university receive academic scholarships.

Because school mathematics plays such a critical role in filtering opportunities for college (Tate, 1995) and advanced mathematics course-taking has such substantial and positive effects on college enrollment (Byun, Irvin, & Bell, 2015), college bridge programs typically feature a mathematics component. Presuming that explicit college and career readiness teaching will increase the subsequent participation of youth from under-represented groups, bridge programs tend to emphasize academic and psycho-social readiness through academic knowledge, academic success behaviors, and technical knowledge and skills, in addition to the cultivation of personal resources such as self-esteem, self-efficacy, and independence (Hooker & Brand, 2009). Structured around this logic, this particular college-bridge program includes a variety of learning experiences during fall, winter, and summer programming sessions; during summer, participants engage in a 2-week summer math camp program.

Participants

Participants for this bridge program must be zoned to specific communities that include large Black populations of varying income levels (see Table 1). Each cohort is comprised of 120–150 students considered “successful” by traditional academic standards (grade-point average and standardized tests); academic records are one of the criteria the university admissions office uses to select participants. While participating students may have high achievements in specific and/or multiple academic areas, their mathematical competence and interest in the subject varies widely.

Implementation

In the summer of 2016, the *MaJIC* curriculum was used over 8 days for 5 hours per day. During

Table 1.
Demographic Details of Bridge Program
Focal Community Areas.

Area	Average representation within a cohort	% of the population in this area who identify as Black or African American	Median household income
A	20%	79.7%	\$26,249
B	50%	69.4%	\$50,371
C	30%	27.2%	\$33,055

Source: 2017 census estimates.

the first 4 days, lessons highlighted the 3 strands of the *MaJIC* curriculum. During the final 4 days, students developed individual and group projects related to a social issue of their choice or created TED-like talks about a mathematics identity or meta-cognition topic to showcase their learning to parents, community members, and university stakeholders. This important moment within the program allows these learners to be recognized as mathematics experts by socially-significant individuals. Recognition that cultivates one’s sense of belonging is a critical aspect of identity development (Wenger, 1999), and this experience allows students to assert themselves as mathematics/STEM people and be publicly assigned by others as such people.

The Silhouette Activity

Naming and narrating harm are key aspects of restoration and reconciliation. One pivotal activity in the *MaJIC* curriculum, the Silhouette Activity, guides students to create silhouette posters featuring external messages they receive about mathematics and internal messages they tell themselves. These artifacts effectively capture dominant discourses in mathematics classrooms (Hottinger, 2016; Shah & Leonardo, 2016) and the intrapsychic scripts about mathematics that mediate students’ engagement in mathematical work. Once complete, the posters are hung around the classroom and students move from poster to poster reading about their peers’

messages listed in Table 2 reveal a complex web of pressures and demands that are largely, but not entirely, negative. Despite seemingly varied levels of mathematical success, the internal messaging reveals an intrapsychic script that reflects tensions between an aspirational and actual self. Yearning and hopefulness for mathematical success seems to be mediated by self-doubt, and while some messages reveal explicit evidence of the racialized and gendered aspects of children's mathematics identities, such messaging does not appear uniformly across the posters.

The 4 silhouette posters (Figure 2) exemplify the complexity of Black student experiences in mathematics classrooms. The external



Table 2.
Internal and External Messages on Each Poster.

	<i>Internal</i>	<i>External</i>
Student A (Girl)	<ul style="list-style-type: none"> ● I'm good at math only ● Can I figure this out? ● Take you time ● I like math ● I can do better ● I try my hardest ● I challenge myself ● Why didn't I get 100 	<ul style="list-style-type: none"> ● You're good at math, do this ... ● How do you solve this problem? ● You always get an A ● Aren't you supposed to be good at math? ● Why are you so good at math? ● Can you help me with this since your good at math ● If you're good at math how come you got this wrong ... ● Sit next to me I'm cheat off you. ● You're incredibly smart ● Try this extra credit problem since you got his right ● You will succeed. ● You (are) stupid!! ● "I thought you know what you were doing." ● Keep trying, believe you can succeed. ● You don't need the approval of others to be great. ● You won't ever be anything. ● Math is not your strong suit. ● Stop raising your hand, you're always wrong every time. ● What's the purpose of math? ● Terrible. ● This is way too hard. ● Thank you for helping me! ● You're good at math. ● I don't get it. ● You're stupid! ● I don't need math. ● I don't get it. ● This is dumb! ● Boys are math than girls. ● I Quit! ● You scare me! ● You're black & smart! ● You skipped a grade and doing 11–12 grade math, wow!!! ● You're born in '04?!? ● You make me feel dumb ● You're a math genius!
Student B (Boy)	<ul style="list-style-type: none"> ● Success is my middle name. ● To be an engineer, I must know math. ● So what if I am wrong ... I learn more from mistakes. ● Keep working hard. ● Self-motivation. ● To be better than those who believe you can't be great, don't try to prove them wrong [illegible] prove it to yourself and only yourself. 	
Student C (Girl)	<ul style="list-style-type: none"> ● I'm never going to get this. ● I don't want to ask for help though. ● What do I need math for? ● How does everyone know more math than me? ● I'm so confused. ● Man, I wish I was good at math. ● No! I can do it. Just don't give up. ● I'm going to fail this. ● This is way too hard. ● Try harder. ● OMG. ● Not my favorite subject. 	
Student D (Girl)	<ul style="list-style-type: none"> ● You can do it! ● If you don't get this, you're slow. ● You're really good at math but you can be better. 	

The Restorative Process of the Victimized

While these Black learners did not consciously construe themselves as victims, a historical gaze at mathematics clarifies patterns of racialized disenfranchisement to and through the discipline (Berry, Pinter, & McClain, 2013). Contemporary mathematics classrooms expose many, if not most, Black children to persistent, dulling violence within a social order of White, patriarchal supremacy (Martin et al., 2018). The silhouette posters allow Black children to explore the tensions around their emotions (positive and negative), their hurts, and their hopes in a generative manner as they name and reflect on the inner negotiations of everyday life.

Ideally, the restorative process allows victims to seek information, tell their truth, exert control (or empowerment), and protect themselves from blame (or vindication) (Zehr, 2014). In this vein, the Silhouette Activity helps learners see the unique and common aspects of their mathematics learning experiences. Critical to identity development and repair, such information gives young people a means to self-situate and calibrate themselves against their peers. Poster creation also provides space for Black children to tell their respective and collective truths, and author their mathematical experiences in ways that extend one-dimensional narratives about achievement disparities. For many students, the silhouettes provide a way to account for the costs and confusions of high achievement and the tenuousness of success.

The narration and re-authoring of self is fundamental to identity development and repair, and the silhouettes thus become artifacts of vindication. Instead of internalizing their mathematical experiences as personal failings, obstacles, or successes, Black learners see their experiences as part of larger systems of teaching and curricula that include peer, media, and parental influences. Noting that this new perspective does not become debilitating or result in a loss of agency, we argue that these new insights and awareness can actually channel and build students' agency and navigational capacities as they continue to move through educational and social settings and systems. Specifically, when learners start to

recognize patterns in the obstacles and resources that characterize their experiences, many begin developing strategies to maintain a more complete and grounded sense of self.

Conclusion

While the complex relationships between Black children and mathematics are increasingly accepted as problematic and in need of repair, mathematics education repair initiatives are too often narrowly implemented as a technical approach: remediation. Remedial tracks in mathematics abound and have become replicated at the post-secondary level as developmental mathematics courses designed to repair misconceptions and gaps stemming from K-12 mathematics.

The fundamental premise that mathematics teaching and learning require a technical fix is challenged by the voices of Black learners who narrate and illustrate a set of contextual and relational challenges that make mathematics learning difficult. We propose an alternative relational fix to mathematics learning and development -built on the principles of restorative justice. We believe a form of mathematics therapy centered on reparations and reconciliation, such as the *MaJIC* curriculum, should be integrated into mainstream mathematics curricula to provide communal opportunities for learners to process the inter- and intra-personal demands of mathematics learning. Such restorative work is especially critical in mathematics classrooms because these spaces are often a gateway to subsequent educational and professional opportunities.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Additional Resources

1. Aguirre, J. M., Mayfield-Ingram, K., & Martin, D. B. (2013). *The impact of identity in k-8 mathematics learning and teaching: Rethinking equity-based practices*. Reston, VA: National Council of Teachers of Mathematics.

This important book explores the role of identity in children's mathematics learning and assists educators in reflecting on their various identities as mathematics teachers.

2. Boaler, J. (2014). *How to Learn Math: For Students*. [Online course.] Retrieved from

<https://lagunita.stanford.edu/courses/Education/EDUC115-S/Spring2014/about>.

This online course includes several video modules that allows students to explore mathematics and their relationship to mathematics.

3. Kokka, K. (2018). Healing-Informed Social Justice Mathematics: Promoting Students' Sociopolitical Consciousness and Well-Being in Mathematics Class. *Urban Education*, 1-31.

This article describes how teaching mathematics for social justice offers children opportunities to engage in healing practices.

