

A Research Agenda for Culturally Responsive and Sustaining Education in Mathematics:

*Essential Directions, Methodological
Approaches, and Guiding Principles*

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Introduction

Culturally responsive and sustaining education (CRSE)¹ has generated interest from a wide range of audiences in mathematics education over the past three decades. CRSE has emerged as an approach to learning, teaching, and schooling in response to the racialized nature of many mathematics classrooms. Over the past three decades, there has been an increasing amount of research focused on what CRSE in mathematics is, why it matters, and what it looks like in practice, yet less is known about *how* to support the implementation of CRSE sustainably and at scale. In this report, the authors raise critical questions and offer essential directions, methodological approaches, and guiding principles for CRSE research that can promote and support the implementation of CRSE in mathematics.

As argued by Nasir (2016), mathematics educators, researchers, and the broader field of mathematics education must be centrally concerned with issues of race and culture as they are “not only core to the learning process but also they are central forces that organize our society and determine access to high-quality mathematics instruction” (p. 7). Educators and education researchers have traditionally viewed mathematics instruction and learning as race-neutral and culture-free. In mathematics, objectivity and abstraction are often valued as the highest form of intellect, which not only deprioritizes the contextualized nature of mathematics, but also constrains what students of color are able to display intellectually (Gutierrez, 2013; Matthews, 2018). The misleading conceptions of mathematics instruction as race-neutral produce racialized mathematical and nonmathematical narratives about Black and Brown students that are often steeped in bias and dramatically impact their relationship to mathematics (Larnell, 2016; Martin, 2006; Nasir & Shah, 2011; Shah, 2017; Spencer & Hand, 2015).

¹ CRSE is an approach to education that seeks to advance educational equity by creating culturally affirming and inclusive learning environments, experiences, and outcomes for each student. CRSE is informed by a constantly evolving cross-section of research and fields of study, including culturally relevant pedagogy (Ladson-Billings, 1995), culturally responsive teaching (Gay, 2000), culturally sustaining pedagogy (Paris, 2012), racial identity development, bilingualism, student agency, critical race theory, and social and emotional learning.

Research in mathematics education has documented long-standing disparities in who has access to high-quality mathematics instruction, rigorous and cognitively rich tasks, and mathematical discourse, demonstrating differences in the access Black and Brown students have in comparison with their White peers (Battey & Leyva, 2016; Martin, 2019; Spencer & Hand, 2015). Furthermore, research has demonstrated that due to biased narratives embedded in education, teachers of Black and Brown students place an overemphasis on monitoring behavior, frequently isolate these students from their peers or classroom learning environment, and frequently resort to exclusionary discipline practices (Battey & Stark, 2009; Nasir, 2011; Snyder et al., 2012). In these ways, mathematics classrooms are racialized; “racial storylines” act as cultural artifacts that not only shape the way people “collectively make sense of (and reproduce) achievement patterns,” but also shape students’ perceptions of their ability to do mathematics (Larnell, 2016; Martin, 2006; Nasir & Shah, 2011; Shah, 2017; Snyder et al., 2012; Spencer & Hand, 2015).

These disparities are theorized as being tightly connected to neoliberal projects, which are rooted in a free-market ideology that prioritizes competition, privatization, and the production of skilled labor for labor markets. CRSE scholars have revealed the many ways that neoliberal mathematics reform is a racial project, calling for the rejection of these outcomes in favor of outcomes that center student learning and participation, student identity and disposition development for mathematics, and the development of critical consciousness through mathematics (Ladson-Billings, 1995; Lipman, 2012; Martin, 2013). To address and combat these long-standing disparities and to draw upon the strengths and assets of Black, Brown, Indigenous, and other marginalized communities, CRSE has emerged as educators shift pedagogy toward the strengths that students of color bring to the classroom.

The promise of CRSE has sparked a wide range of research on its principles and its implementation. Existing literature on CRSE has typically focused on unveiling how exemplary CRSE learning environments promote student engagement, participation, and achievement in mathematics (Abdulrahim & Orosco, 2020; Aronson & Laughter, 2016); the challenges, barriers, and resistance associated with CRSE implementation (Neri et al., 2019); and the central tenets and outcomes of CRSE (Milner, 2017). This body of work has shaped what CRSE implementation is and should be and has helped to establish evidence of the effectiveness of CRSE on a wide range of student outcomes. However, the literature surfaces several opportunities and priorities for new research to advance CRSE. One such priority concerns the implementation of CRSE. Although several frameworks exist that articulate dimensions of CRSE and what CRSE

should ostensibly be in mathematics (e.g., Milner, 2017), how CRSE is enacted and how to support its implementation remain understudied. CRSE scholars note that CRSE enactments in the field often do not meaningfully reorganize teaching and learning to bring in the cultures and strengths of students who come from marginalized backgrounds, falling short of the tenets and promise of what CRSE ostensibly is and should be (Ladson-Billings, 2014; Milner, 2017). Research illuminates the challenges and barriers to implementing CRSE with integrity, such as a lack of professional learning structures for developing educators' capacity to implement CRSE and a lack of curricular materials and pedagogical models to support its implementation, particularly in mathematics (Neri et al., 2019).

These research priorities around CRSE implementation in mathematics necessitate methodologies that span the boundaries of research and practice. An attention to CRSE implementation—and to *systematizing* CRSE implementation—requires approaches that are well-suited for collaborative research partnerships with educators to meaningfully attend to the contexts in which CRSE implementation occurs. Accordingly, this report highlights participatory, collaborative, and improvement methodologies that foreground partnerships with educators to support and learn from their work (Russell & Penuel, 2022). These methods prioritize the needs of education participants and the systems and processes that constrain and enable educators to carry out culturally relevant and sustaining mathematics education. Rather than solely emphasizing the production of scholarly knowledge, the authors of this report prioritize approaches that are well-suited to understanding and responding to the day-to-day implementation needs of educators in hopes of spreading CRSE and making it sustainable within schools. This report aligns with the work of researchers such as Penuel and colleagues (2015) and Datnow (2002), who have called out the shortcomings of the translation model of educational reform whereby researchers generate scholarly knowledge and practitioners are meant to translate this research into daily practice. Much like CRSE presents a student-centered approach that recognizes and builds off of students' everyday experiences, this report makes the case for a research agenda that is practitioner centered, student centered, and focused on everyday dilemmas in classrooms and schools.

The core sections of this report are organized by four dimensions of a research agenda for supporting and studying CRSE implementation in mathematics. These four dimensions, which draw on existing CRSE literature and can shape opportunities for future research, are as follows:

- Reframing outcomes of CRSE in mathematics
- Building mathematics teachers' capacity to enact CRSE
- Codesigning CRSE with families and communities
- Developing organizational processes to support CRSE

These dimensions of a research agenda for CRSE in mathematics are not independent of one another; rather, they intersect and merge in activity (see Figure 1 for a visual depiction).

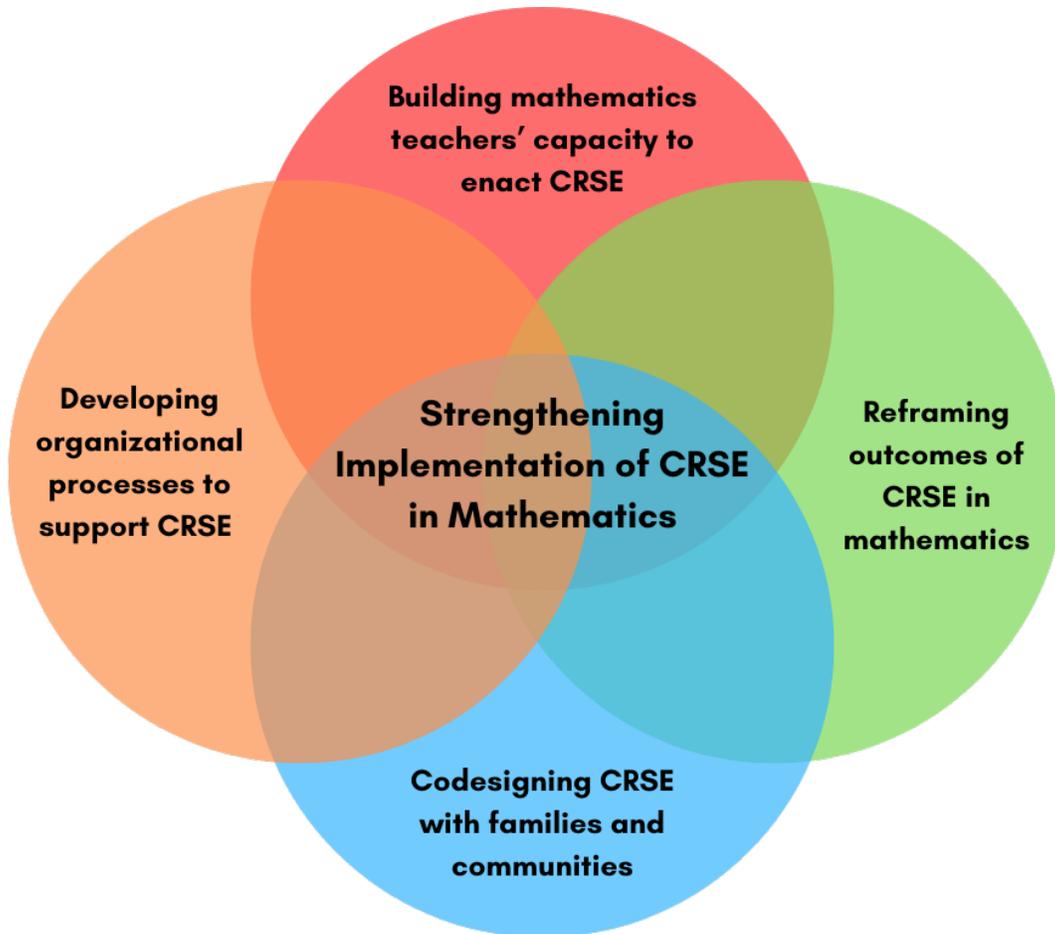
The four domains correspond to four overarching questions of the proposed research agenda. These questions situate schools as the central sites of change and practitioners as the central actors responsible for implementing CRSE (which by no means lessens the imperative of also centering students, families, and communities in the work). The questions are as follows:

- How can schools and practitioners articulate, establish, build support for, and measure core outcomes of CRSE in mathematics?
- How can schools and practitioners build teachers' capacity for implementing CRSE?
- How can schools and practitioners engage in codesigning with families and communities to support the implementation of CRSE?
- How can schools and practitioners establish the organizational structures and routines necessary for supporting the implementation and spread of CRSE?

These four questions are critical for moving beyond what CRSE is and what it looks like in practice toward a research program that is centrally concerned with *how* to support the implementation of CRSE sustainably and at scale.

This report articulates this proposed agenda by describing the four dimensions in detail, highlighting central questions of each. Then the report describes methodological approaches for doing the dual work of supporting *and* studying the implementation of CRSE in mathematics, highlighting both the most urgent research needs and how research ought to be conducted to address these needs. Finally, the report describes how carrying out this research agenda might support a movement toward systematizing CRSE approaches in mathematics education.

Figure 1
Research Agenda for CRSE in Mathematics



Reframing Outcomes of CRSE in Mathematics

This section highlights CRSE research that critiques overreliance on dominant outcomes, or outcomes that have traditionally been seen as the primary or most important outcomes of mathematics education. CRSE research argues that traditional notions of “proficiency” and “achievement” constrain and limit the learning and performance of students of color (e.g., Aronson & Laughter, 2016; Cunningham, 2019; Gonzalez et al., 2005). Focusing solely on dominant outcomes of mathematics education can limit the power and meaning of CRSE. Milner (2017) highlights different, aspirational outcomes for culturally relevant pedagogy that include empowering students to see contradictions and inequities in local and larger communities; incorporating student culture in curricula; and creating classroom contexts that build critical consciousness and cultural competence. Howard and Rodriguez-Minkoff (2017) surface scholarship that foregrounds exemplary enactments of CRSE that support these outcomes, as well as a range of other outcomes that center student learning and experience.

Additionally, research on equitable mathematics learning and teaching highlights several outcomes that are not typically prioritized at scale in large educational systems. These include developing students’ mathematical identities (Gresalfi & Hand, 2019; Nasir, 2002; Nasir & de Royston, 2013); positioning students as co-constructors of mathematical knowledge (Boaler, 1998); broadening and developing student participation in mathematical discourse (Esmonde, 2009a; 2009b; Yackel & Cobb, 1996); and developing students as competent doers of mathematics (Aguirre et al., 2013). In addition, it is often left unclear how to include outcomes that matter to communities and families. CRSE teaching and learning does not happen in a vacuum; it requires intentionality, which includes partnering with families and the surrounding community to identify CRSE outcomes that matter to them and are aligned to their aspirations. Although there is less evidence linking CRSE practices specifically to these mathematical

learning outcomes, extensive research exists that illustrates a range of adjacent practices and their connection to these outcomes (Bartell et al., 2017).

Research is needed on how to prioritize and institutionalize these broader sets of outcomes in schools and school systems. Student outcomes such as their development of mathematical identity, practice, and empowerment are widely seen as critical drivers of mathematical competence and success. Yet, educational systems do not systematically attend to and, as a result, do not develop supports and measures for these outcomes. CRSE research should aim to systematize these outcomes so that they are equally as important as (and as crucial to the attainment of) outcomes that have more traditionally been prioritized in research (the dominant outcomes). Researchers can begin to prioritize other outcomes in part by developing and implementing new measurement systems that attend to mathematical identity, participation, and practice. In turn, doing so can help leverage students' cultural differences as strengths in the mathematics classroom and may help improve their attainment of dominant and nondominant outcomes.

Nonetheless, dominant outcomes still hold currency in educational settings and are prioritized in incentive structures, requiring the attention of any research program focused on supporting sustainable and systematic implementation of CRSE in mathematics (Howard & Rodriguez-Minkoff, 2017; Neri et al., 2019). Too often, the usefulness, value, and relevance of CRSE is limited to addressing student motivation or engagement rather than being seen as valuable for academic achievement and rigorous student learning (Aronson & Laughter, 2016; Ebersole et al., 2016; Farmer et al., 2005). Through her work with administrators and teachers, Young (2010) found that when defining CRSE, teachers rarely make any reference to academic success. She explains that students' cultural capital is most often regarded as "the means to build learning on their personal experiences and to make the curriculum meaningful to them but not necessarily as a way to promote rigorous academic learning" (p. 252). Redman (2014) reported similar findings in relation to content mastery in her work with novice science teachers who displayed "attitudes that culturally relevant pedagogy is valuable more for its ability to motivate and engage students than actually help them to understand science" (p. 157). Reflecting on their efforts to implement CRSE, the teachers in her study reported an incongruence between learning content standards and implementing CRSE, as they found it challenging "to 'juggle' the need to teach 'rigorous science curriculum' and 'make it culturally relevant'" (p. 159). When teachers doubt the value of CRSE for rigorous academic learning, issues of race and culture are often minimized, ignored, pushed to the background, or treated as an add-on if time permits

after attending to content standards and academic achievement measures, all of which can negatively impact Black and Brown students. To promote the implementation and spread of CRSE, teachers need help making powerful connections between CRSE, academic achievement, and content standards.

There is a need for research that bolsters the connections between CRSE practices and student outcomes, including dominant outcomes (e.g., achievement and proficiency) as well as nondominant outcomes (e.g., mathematical identity development and critical consciousness) that scholars of mathematics education and CRSE have identified. Although there is evidence that CRSE practices support a wide range of positive outcomes for students, making the connections between them will enable educational systems to learn how to better implement CRSE and build support for the spread and scale of CRSE practices.

Accordingly, this report centers on the following research questions related to outcomes in CRSE in mathematics:

- How can educators be supported in making connections between content standards, academic achievement, and CRSE?
- How can outcomes of equitable and student-centered mathematics learning and development become prioritized in educational settings?
- Which outcomes are addressed by student-facing educational organizations that systematically implement high-quality CRSE?
- How can families' and community members' learning and aspirations be identified and included in developing CRSE outcomes?
- Which activities support implementing CRSE in ways that focus on improved student outcomes?

Building Mathematics Teachers' Capacity to Enact CRSE

Despite the growing evidence base for CRSE, the existing political climate has further constrained whether and how teachers can discuss issues of race and culture in their classrooms. Legislation in many places throughout the United States has placed strict limitations on the extent to which teachers can discuss race or racism with their students (Gross, 2022; Meckler & Nathanson, 2022). These policies have heightened the need for teachers to become proficient in implementing CRSE in political environments that increasingly do not support them in doing so. In line with Bartolomé (2007) and Hand (2012), the research agenda presented in this paper calls for supporting teachers to understand how the broader sociopolitical context of schooling shapes the learning environments that they are tasked with creating to advance CRSE. Given the interconnectedness of CRSE and critical race theories (Brown-Jeffy & Cooper, 2011), educational systems must also help teachers develop a critical consciousness that enables them to create opportunities for students to interrogate power structures and hierarchies both within schools and outside them (Gutstein, 2003; Bartell et al., 2017).

Professional learning activities should support teachers to be well-prepared moment to moment and day to day. There exists a large body of research around teacher professional learning for equitable mathematics instructional practice (e.g., Goldsmith et al., 2014) and abundant literature supporting high-quality teacher professional development broadly (e.g., Guskey & Yoon, 2009; Desimone et al., 2002). Researchers have found that quality professional learning activities include sustained and frequent opportunities to learn, are situated within the context of teachers' work, enable teachers to develop their own content knowledge, and provide teachers with opportunities to engage in collaborative inquiry with one another using classroom data (broadly defined).

Professional learning should also include access to high-quality CRSE materials and resources and support teachers in learning how to diversify existing curricula and assessments. Studies demonstrate that teachers' knowledge of how to execute CRSE is greatly hampered by a lack of high-quality, culturally relevant curricula and resources; the absence of consensus around pedagogical models of instruction that support CRSE; and a scarcity of successful examples of CRSE work in varied settings (Aronson & Laughter, 2016; Borrero et al., 2018; Esposito et al., 2012; Montalvo et al., 2014; Underwood & Mensah, 2018). Teachers often are charged with the task of "making it up as they go along," having to find, choose, or develop their own materials. Diversifying curriculum and pedagogy requires mastering a great amount of content, having a great deal of racial and cultural knowledge, and knowing one's students well enough to make rigorous learning connections that can then be used to design and facilitate CRSE. Teachers have reported the task of diversifying curricula and pedagogy to be very challenging, especially when the resources available to them homogenize educators and students (Borrero et al., 2016; Esposito et al., 2012; Freire & Valdez, 2017; Royal & Gibson, 2017). Furthermore, there remains a lack of adaptable pedagogical strategies for identifying and integrating students' funds of knowledge into instruction (Goldenberg, 2014; Warren, 2014), making it challenging for teachers to diversify curriculum and pedagogy in a timely manner.

High-quality professional learning activities should also differentiate for the personal and professional identities, knowledge, and needs of teachers. Howard (2006) explains that knowing one's students requires knowing oneself. Often, teachers' cultural frames of reference not only are incongruent with those of their students, but also are privileged in society. This situation takes on heightened meaning for White teachers whose conceptions of cultural capital are largely congruent with and reinforced by dominant narratives. Conversely, teachers of color are more likely to share cultural frames of reference with their students, but here it is important to remember that identity is intersectional, fluid, and rooted in context. Studies have suggested that prior educational experience, age, socioeconomic status, language, and religion can lead to incongruencies between students' cultural frames of reference and those of their teachers of color as well (Coffey & Farinde-Wu, 2016; Freire & Valdez, 2017; Philip, 2011). The fluidity of culture calls for inquiry-focused and differentiated professional learning activities that provide teachers with the time, tools, and resources to critically examine their cultural frames of reference, how they misalign or align with those of their students, and how this (mis)alignment plays out in classroom interactions and instruction.

The misalignment or alignment between teachers' and students' cultural frames of reference also has a significant impact on teachers' willingness and ability to facilitate discussions and learning focused on sociopolitical inquiry. Ladson-Billings (2014) explains that even when teachers embraced culturally relevant pedagogy and "searched for cultural examples and analogues as they taught prescribed curricula . . . they rarely pushed students to consider critical perspectives on policies and practices that may have direct impact on their lives and communities" (p. 78). To facilitate contextualized, relevant, and rigorous instruction, teachers must be aware of the types of sociopolitical issues that their students and their families and communities experience. This keen awareness is crucial for creating curriculum, lessons, and tasks that support students in working through, responding to, and taking concrete action on critical issues that directly affect their lives. However, the literature demonstrates that teachers often lack the know-how needed to facilitate discussions and learning around sociopolitical inquiry (Aronson & Laughter, 2016; Borrero et al., 2016; Johnson, 2011), causing them to doubt the appropriateness and value of sociopolitical inquiry (Freire & Valdez, 2017; Young, 2010) and to fear being labeled racist (Bell, 2002; Buehler et al., 2009; Evans, 2007; Gregory & Mosely, 2004). Teachers need support facilitating constructive dialogue among students, adapting sociopolitical inquiry to specific grade levels and disciplines, and utilizing productive discussion strategies when they do not have answers for students' questions.

Professional development programs must also attend to context when differentiating CRSE learning for teachers. A successful inquiry-based professional learning environment (Esposito et al., 2012; Ryoo et al., 2015) encourages teachers to explore innovative practices through experimentation (Elmore, 1996; Gay, 2013; Taba, 1962); make requests for support (Drago-Severson & Blum-DeStefano, 2017); and engage critical concepts of belief and know-how related to race and racism (Philip, 2011). Yet, in the face of increased scrutiny, schools often succumb to the pressures of standardization and hyper-accountability by emphasizing standardized teaching and assessment practices (Bianchini & Brenner, 2010; Flores, 2007), minimizing the significance of race and culture, and implementing punitive evaluation (Cramer et al., 2018; Stillman, 2011). School cultures like these do little to promote inquiry-based teacher learning; in addition, they heighten levels of professional vulnerability and isolation that make it challenging for teachers to engage in innovative efforts such as implementing CRSE. Professional learning activities focused on the implementation of CRSE must be differentiated in ways that support teachers' efforts to navigate the sociopolitical and organizational contexts of their educational system.

As the literature reveals, teachers who express interest in learning about and implementing CRSE often feel isolated in their efforts to counter deficit perspectives of students and often perceive their work to be in direct opposition to school goals (Borrero et al., 2016; Buehler et al., 2009; Hyland, 2009). Teachers report that their efforts to engage colleagues in conversations about race, culture, and CRSE are overwhelmingly perceived as threatening (Arce, 2004; Drago-Severson & Blum-DeStefano, 2017) and are often subject to critique (McKenzie & Scheurich, 2008), amplifying their feelings of vulnerability and isolation. Furthermore, multiple examples reveal that teachers who are interested and actively engaged in CRSE efforts are often subjected to professional isolation by leadership and colleagues through being openly reprimanded (Underwood & Mensah, 2018) and being blatantly overlooked for leadership and professional development opportunities (Kohli & Pizarro, 2016). When school leaders and colleagues do not value CRSE or even actively disrupt CRSE efforts, sustaining the work is increasingly challenging (Gay, 2014; McIntyre, 1997). As feelings of isolation grow, some teachers develop a fear of blame from colleagues (Esposito & Swain, 2009), and others experience fatigue about being the only ones willing to challenge the status quo. In the face of increased scrutiny, teachers are more likely to abandon efforts like CRSE that fall outside the purview of district- or state-level policy mandates and are perceived to have limited instructional value in support of school priorities (Mette et al., 2016; Sleeter, 2012).

Teachers of color also experience the additional work of cultural and social brokering, intervening on behalf of students of color when they are being mistreated by adults or peers and serving as liaisons to family and community. Teachers of color are also subjected to witnessing and making difficult decisions about how to respond to daily acts of discrimination and racial microaggressions toward themselves and their students of color. Addressing these acts of discrimination often means educating their White colleagues and students, navigating power dynamics with colleagues, and dealing with potential backlash from students' families and communities. However, not addressing these acts means teachers of color and their students of color continue to do the extra work of fighting for equitable access to high-quality instruction and combating the internalization of oppression. Different teachers have different identities, experience and commitment levels, and contextual barriers and affordances. Accordingly, they need different types of professional learning supports and programs to navigate the sociopolitical and organizational contexts of their educational system to implement and sustain CRSE efforts.

Although there is guidance on what constitutes quality professional development generally, there is less clarity about how to reliably and systematically create differentiated learning opportunities to enable teachers to implement CRSE in mathematics. In a review of literature on professional development programs aimed at supporting multicultural education and culturally relevant pedagogy, Parkhouse and colleagues (2019) found that few studies of these programs existed, and those that did surfaced unresolved challenges related to participants' reluctance to change and skepticism about multicultural education and cultural relevance. Research on cultural responsiveness and mathematics teacher learning highlights studies of isolated professional learning activities, most often facilitated and led by researchers (e.g., Aguirre & del Rosario Zavala, 2013; Battey & Franke, 2015; Hynds et al., 2011). Although these studies have utility, there is a need for investigations that are more systematic as well as for the enactment of professional learning for building teachers' capacity to implement CRSE. Specifically, there is a need for research that seeks out, documents, and studies schools, districts, and other sites with existing, robust professional learning structures and routines for building mathematics teachers' capacity for CRSE.

Thus, the professional learning dimension of the CRSE research agenda is concerned with working collaboratively with practitioners—school and district leaders and teachers—to design lasting, sustainable, and reliable professional learning structures, routines, and activities that support teachers' inquiry into their own identities and practices. Rather than generating research that school leaders are meant to translate, researchers need to work with practitioners to identify, implement, and scale promising professional learning activities and structures. Engaging in this kind of research is an opportunity to develop the capacity of systems to use evidence to implement CRSE. One element of such research could involve designing practical measures for enabling mathematics teachers to reflect on their instructional practice as it pertains to equity and justice in mathematics classrooms (Takahashi, 2022). Such practical measures could enable educators to improve and establish routines that ensure quality day-to-day practices.

The questions centered around professional learning for CRSE in mathematics are as follows:

- How do schools and districts design, implement, and sustain robust professional learning programs for CRSE?
- How do teachers assess and adapt their practice to implement CRSE?

- How can leadership develop a culture of learning that empowers teachers to innovate and change their practices to implement CRSE?
- How can schools and districts support teachers in their daily practices as they learn how to implement CRSE?
- How can supports and professional learning activities be differentiated for teachers based on their personal identities, professional backgrounds, and commitment to and level of experience with CRSE?
- What are effective coaching and mentoring models for supporting teachers' efforts to implement CRSE?
- How can teachers use artifacts of practice (qualitative and quantitative classroom data, including practical measures) to incorporate CRSE into their daily routine?
- Which professional learning supports and systems can help teachers in developing dispositions that promote CRSE?
- Which supports do teachers need in order to facilitate classroom discussions on and learning from sociopolitical inquiry?
- What are the learning supports, structures, routines, and experiences that enable teachers to implement CRSE in service of dominant and nondominant outcomes?

Each of these questions is concerned with supporting teachers to engage in critical inquiry into their own identities and practice. Doing so is deeply intertwined with the aforementioned outcomes dimension; these outcomes are under the purview not just of school and district leaders but also of teachers who are in need of tools to gauge, reflect on, and improve their practice.

Codesigning CRSE With Families and Communities

A central tenet of CRSE is the uptake of students’ cultures, communities, and families into learning environments, including redesigning these learning environments to center students’ experiences and backgrounds. Through their extensive body of work on family–school partnerships, Moll and colleagues (1992) have demonstrated how honoring students’ funds of knowledge—skills, knowledge, and practices that students and their households use to thrive on a daily basis—and integrating those funds into classroom instruction are practices that enhance students’ learning and performance, build trust with families and communities, and provide opportunities for families and communities to participate in ways that are meaningful and authentic to their experiences. However, much of the research on CRSE implementation in mathematics education occurs in the classroom or school context, with far less research being conducted with families and communities in empowering ways that acknowledge parents and caregivers as mathematicians and homes and communities as sites of mathematical learning (Cunningham, 2021; Gonzalez et al., 2005).

Issues of power and authority surface as community–school research partnerships are formed with populations that have been historically marginalized and viewed as disinterested or ill-equipped to make contributions to their children’s education broadly and to mathematics learning specifically. For example, Matthews and colleagues (2021) note that during the first year of the COVID-19 pandemic, some of the Black parents in their study felt suddenly inundated with communications from schools and teachers that had previously ignored them, due to the perceived “learning loss” attributed to remote learning. These types of assumptions and relationships with families can make it difficult to create the foundation of trust that is necessary for codesigning and collaborating.

Although codesigning curriculum with students, families, and communities is well-aligned with the CRSE values of caring for students as whole beings and honoring the cultural knowledge students bring to school, the practical application of these values to curriculum can be difficult to pinpoint. Building from existing research on family engagement that highlights a range of promising practices and structures (e.g., Ishimaru, 2014; Ishimaru et al., 2016) and offers practical models for teachers to recognize and integrate students' funds of knowledge into curriculum and pedagogy (Moll et al., 1992), further research should specifically engage students, families, and communities in the explicit work of creating CRSE learning environments. More needs to be understood about the conditions that build trust with the communities and empower family and community members, regardless of education level or profession, to contribute to classroom experiences in meaningful ways. For example, more research ought to be conducted into how Black and Brown families and communities are engaged in the work of identifying, adapting, and contextualizing mathematics curricula in ways that make curricular materials and tasks more culturally responsive and sustaining.

Codesigning CRSE with families and communities should also provide space for family and community members to critically reflect upon their own identities, experiences, and assumptions about the purposes of schooling and, more specifically, of mathematics. Otherwise, community–school research partnerships can act to reinforce and reproduce deficit approaches to mathematics education. As Freire (2007) explains, the oppressed—without naming, being critical of, and acting upon one's reality—may strive to become the oppressor rather than striving for liberation. Community–school research partnerships are needed to provide family and community members with opportunities to critically reflect upon and name their reality, to dissent and push back, and to further develop their critical consciousness. So, too, is there a need for school leaders and practitioners to critically reflect on themselves and welcome and learn from families and community members about their realities. Doing so requires community–school research partnerships to include recognizing and addressing power dynamics that make it challenging for families and communities to show up as their authentic selves and trust that their ideas and feedback will not only be heard, but also be understood and valued. At the same time, these partnerships must address the power dynamics that make it challenging for schools and practitioners to deeply hear, understand, and value the realities that families and communities share. CRSE-focused community–school research partnerships also need goals that extend beyond improving schools and classrooms to learning how to

support students, families, and community members in their efforts to mobilize and act on their sociopolitical realities.

The following questions are presented in hopes that they are further explored in future research:

- What are empowering models, practices, and strategies for engaging students, families, and community members in the building and implementation of CRSE?
- What are effective strategies and practices for recognizing, honoring, and integrating students' funds of knowledge into curriculum and pedagogy?
- How and when can teachers codesign CRSE with students, families, and community members to diversify and strengthen curriculum and pedagogy?
- How can practitioners build trust with students' families and communities?
- What are some barriers that impede students, families, and communities in their efforts to authentically participate in community–school partnerships? How can these barriers be addressed?
- How does providing students, families, and community members with opportunities for developing critical consciousness impact their participation and decision-making in community–school partnerships?
- How can schools support students, families, and community members in their efforts to mobilize and act on their sociopolitical realities?
- How do communities become centered in students' use of mathematics for social justice in the community and other community development activities?
- How does the integration of students' funds of knowledge impact classroom learning?

Some scholars have begun to explore methodologies for codesigning CRSE with students and families. For example, Community Design Circles provide “in-depth, reciprocal working groups that aim to engage stories, experiences, and expertise within our communities in order to catalyze action within a particular context” (Ishimaru & Bang, 2016). Using design-based research methods, Chueamueangphan (2021) also found that codesigning culturally relevant STEM (science, technology, engineering, and mathematics) projects with rural Thai students positively impacted student engagement and learning outcomes.

Developing Organizational Processes to Support CRSE

Neri and colleagues' (2019) review of literature on resistance to CRSE in schools used a multilevel lens to examine the experiences of teachers seeking to implement CRSE. One central category of findings included ways in which organizational practices and processes did and did not support CRSE implementation. CRSE implementation is largely influenced by the quality of institution-level supports to which teachers have access and whether they feel safe enough to innovate and learn how to implement CRSE. Unfortunately, high-quality supports for implementing CRSE are limited. Most school, district, and state leaders have not learned why they should provide such supports or how to create these supports, including how to navigate an increasingly unsupportive political environment to develop a culture of learning that encourages teachers to center issues of race and culture and take the risks necessary to change their practice. Too often, teachers are instead faced with punitive and impatient accountability contexts that stifle the spirit of innovation and give way to the fears of uncertainty and failure. Royal and Gibson (2017) also considered organizational structures and processes and how they are related to CRSE implementation. They argue that neoliberal school reform models, such as those employed by the School District of Philadelphia, constrained teachers' capacity to implement CRSE and frequently disempowered them to do so. Cultures of monitoring and standardized practice limited the actions teachers could take to make learning environments culturally sustaining for students.

Inspired by the research and writings cited above, this part of the research agenda proposed in this paper is centrally concerned with embedding and sustaining CRSE in the everyday work of schools. For CRSE to take root and then persist amid leadership changes, staff turnover, and a political climate oriented toward color-evasive racial ideologies (Gross, 2022), research will need to prioritize generating insight into how schools can systematize and institutionalize CRSE. Although one-off, exemplary enactments of CRSE are instructive and beneficial to the students

who experience them, a research agenda concerned with sustaining, spreading, and scaling CRSE to a broader population of students is needed. Such an agenda requires viewing schools as organizations that constrain and enable CRSE implementation and therefore requires prioritizing the development of organizational processes in which schools can engage in order to support integrating CRSE with the rest of what they do.

Although mathematics teacher learning and development are important for implementing CRSE, building teachers' capacity is meaningless without equal attention given to the conditions that allow them to implement CRSE every day—namely, securing culturally relevant curricular and other material resources that support daily CRSE implementation. In addition to highlighting the importance of involving students in the process of shaping culturally responsive materials (Castagno & Brayboy, 2008), decades of research on effective, equitable mathematics teaching have highlighted the central importance of including rich, group-worthy tasks in curricular materials (e.g., Bartell et al., 2017; Boaler & Staples, 2008; Lotan, 2006). Such conditions are no different when seeking to sustain the implementation of CRSE.

Additionally, research indicates that leadership is central to creating and sustaining the organizational conditions and structures for implementing CRSE in mathematics. A growing body of literature has surfaced the role that school and district leaders can play in establishing a culture of learning and innovation that supports CRSE across content areas. Khalifa and colleagues' (2016) review, for example, examined research on school leadership for implementing CRSE and generated four actions that culturally responsive leaders ought to engage in, as follows:

- critical self-reflection, including an interrogation of one's own beliefs and values
- instructional leadership that includes seeking out culturally responsive curricula and materials, creating opportunities for professional learning around CRSE, and recruiting and retaining culturally responsive teachers
- the creation of inclusive, culturally affirming school environments by calling out structures that are exclusionary, such as discipline practices
- deep engagement with students, parents, and communities to understand and incorporate their needs and perspectives into the daily work of schooling

These four actions, Khalifa and colleagues (2016) argue, constitute key pillars of work in which leaders ought to engage to create the conditions under which CRSE is implemented, systematized, and sustained over time. Although research has grown in this area, more

research is needed on how leaders come to develop dispositions and practices for leading in support of CRSE, shielding their teachers from political environments and mandates that work against CRSE, and developing cultures of learning that encourage innovation and long-term change. Additionally, although Khalifa and colleagues surfaced a range of school-level, local instances of CRSE being implemented through leadership, more research is required for understanding the role of districts, county offices of education, and state departments of education in implementing CRSE.

Questions to guide a research agenda that focuses on organizational processes include the following:

- How do leaders come to develop and engage in practices for integrating and sustaining CRSE in schools and districts?
- How do leaders establish a culture of learning that encourages innovation and empowers teachers to take the necessary risks to change their practice, especially in a political climate that actively attempts to constrain CRSE efforts?
- How are curricular materials sought out, secured, and implemented to support routine, everyday CRSE implementation?
- How can CRSE become an organizational endeavor that schools and school systems prioritize?
- How do school and district policies, structures, and cultures constrain and enable CRSE implementation in schools?
- What conditions are required for CRSE to be implemented, sustained, and ultimately embedded in mathematics classrooms?
- How can educators use data and evidence to know if their systems are designed and working in support of CRSE?
- What organizational processes and practices support teachers' use of data (broadly defined) to routinize CRSE in their daily practice?

These questions together convey a need to attend to the everyday work of schooling and the ways in which that work both constrains and enables CRSE. Neri and colleagues' (2019) literature review highlights that CRSE is often implemented as an individual exercise and also that teachers are threatened or discouraged from implementing CRSE in their classrooms. Understanding how this happens at a granular level—and engaging with educators to navigate the structures and processes that position CRSE-focused educators as being at the fringe and

unsupported—can produce insights that may lead to understanding how to better support CRSE implementation. Additionally, viewing CRSE implementation as an organizational endeavor surfaces the need to develop learning and problem-solving infrastructures—CRSE, like many reforms before it, cannot simply be transplanted into schools with standard processes that are expected to be enacted with fidelity. There is a need for infrastructure that informs educators on the careful institutionalization of CRSE as it unfolds.

Prioritizing Methodological Approaches for Advancing CRSE

Each of the dimensions above is grounded in (a) learning how to make CRSE approaches work in daily practice; (b) addressing power-based relationships among students, families, communities, teachers, and school leaders; and (c) improving learning environments by disrupting traditional power dynamics rather than merely studying them as external observers. These orientations support a research agenda that is collaborative and includes participatory research partnerships that center the experiences and priorities of practitioners, students, families, and communities. This agenda draws inspiration from a long history of scholarship aimed at improving and transforming systems of schooling. Such scholarship has included involving students in youth participatory action research (Cammarota & Fine, 2008; Rodríguez & Brown, 2009) and engaging in other kinds of action research (e.g., Brydon-Miller et al., 2003); design-based research (Design-Based Research Collective, 2003); design-based implementation research (Penuel et al., 2011); community-based design research (Bang et al., 2016); research that involves funds-of-knowledge teacher study groups (Esteban-Guitart et al.; 2018; Moll et al., 1992); research–practice partnerships (Gutiérrez & Penuel, 2014); and improvement science (Lewis, 2015).

Each of these approaches originated from the need to address the research–practice gap in education, which exists when scholars accumulate a vast body of literature on “what works” in educational settings that goes unused by practitioners or, worse, informs policies that mandate practitioners to engage in initiatives that are “research-based,” only for those initiatives to fail due to the lack of attention to implementation and context. Schoenfeld (2006), for example, highlights the failures of the What Works Clearinghouse for informing the work of mathematics education reform efforts. The failures of these efforts typically result from a lack of collaboration with practitioners to attend deeply to issues of implementation and day-to-day practice (Penuel et al., 2015). In addition to highlighting the need for collaborative research

partnerships, scholars have pointed to elevating the relevance to practice as a criterion for rigor in scholarship (Gutiérrez & Penuel, 2014), motivating new arrangements in scholarly activities that position practitioners alongside researchers to support and foreground educational improvement over the production of scholarly knowledge.

Thus, an approach to research is needed that foregrounds implementing CRSE in mathematics and supporting the implementation. Research should position practitioners, communities, families, and students alongside researchers through skilled facilitation to enable these interested parties to reach convergence around CRSE outcomes and practices. Future research projects should bring together CRSE scholars, teachers, school leaders, district- and state-level administrators, students, and community and family members to engage in collaborative inquiry on improving learning environments to better center the strengths and assets of communities and youths. Additionally, research ought to consider how these arrangements enable leaders, educators, students, families, and community members to develop crucial dispositions and joint values that are aligned with CRSE. For instance, research ought to highlight the methods and moves through which these collaborations between schools, families, and communities generate convergence around a collective critical consciousness regarding racial, linguistic, and cultural identities that, in turn, motivates the need (and creates conditions) for CRSE implementation. Collaborations like these can enable research and improvement teams to agree on clear outcomes and priorities as they pertain to CRSE, to develop and generate motivation for improvement-focused measurement and inquiry practices and tools, and to identify clear professional learning opportunities for teachers and school leaders.

This work requires creating opportunities for proximity among teachers, school leaders, students, families, and community leaders. For example, in improvement science, empathy interviews and journey maps are one way for teachers and school leaders to understand deeply the experiences of the students and communities they aim to serve (Hinnant-Crawford, 2020). Community walks, in which teachers physically immerse themselves in the communities where they teach and thereby learn about what their students experience, are popular in teacher education programs to create proximity (Wilcoxon et al., 2021). Asset maps, which are visual representations of the strengths of a particular community, aim to enable teachers and members of the school community to understand the existing resources and knowledge in communities that can be drawn on and centered in classrooms (Borrero & Sanchez, 2017). Pitfalls of these practices can include that they are used but not incorporated into ongoing work

or that they are done once and never revisited. These practices are not silver bullets; indeed, there need to be concerted efforts to commit to using these practices in depth and to engaging in sustained dialogue about these practices. Creating proximity to foster more understanding among school leaders, educators, students, families, and communities is just one way that research ought to engage in deeper, more participatory relationships with communities and families to incorporate CRSE into the classroom.

A research agenda that fosters such proximity motivates a need to move past the mere production of CRSE knowledge for mathematics. Researchers should be deeply invested in and oriented toward directly supporting the implementation, spread, and scaling of CRSE in schools so that more students are affirmed, participate in mathematics, and are invested in mathematics. To this end, the following guiding principles are offered to focus future CRSE research agendas, approaches, and funding priorities.

Guiding Principles for CRSE Research

- Focus on day-to-day practice and the actual work of educators within the multilevel context of education.
 - Attend to the multilevel context of implementing CRSE approaches.
 - Be iterative and inquiry-based, focused on making CRSE work in practice.
- Be participatory, positioning researchers alongside, and honoring the expertise of, practitioners, students, community members, and families.
- Engage partners in collaborative sensemaking of data and evidence.
- Seek out and engage with “bright spots” to learn from positive cases in which educators have made CRSE work.

Establishing Guiding Principles for CRSE Research

Focus on day-to-day practice and the actual work of educators within the multilevel context of education. CRSE approaches are not new. They were developed and have been refined by scholars and practitioners for more than 30 years. In that time, researchers have documented the effectiveness of CRSE approaches for serving students, particularly Black, Brown, Indigenous, and other students from nondominant communities. Yet, to this day, the adoption and implementation of these approaches remain sporadic and underwhelming, in large part due to the multilevel challenges teachers face in their efforts to implement CRSE. To spread CRSE approaches, researchers now need to focus on the day-to-day practice of educators, and to do so, they need to work alongside educators to figure out how to make CRSE approaches work in practice.

Attend to the multilevel context of implementing CRSE approaches. Neri et al. (2019) explain that effective implementation of CRSE is not just a matter of teachers' content, pedagogical, and racial and cultural knowledge. It is also greatly influenced by the quality of institution-level supports to which teachers have access and by whether teachers feel safe enough to innovate and learn how to implement CRSE. Unfortunately, high-quality supports for implementing CRSE are limited. Most school, district, and state leaders have not learned why they should create these supports or how to do so, including how to navigate an increasingly unsupportive political environment in order to develop a culture of learning that encourages teachers to center issues of race and culture and take the risks necessary to change their practice. Too often, teachers are instead faced with punitive and impatient accountability contexts that stifle the spirit of innovation and give way to the fears of uncertainty and failure. Given the multilevel nature of the challenge of implementing CRSE, there is a need for research that illuminates and learns from contextual variation in the implementation of CRSE. Framing

implementation as a multilevel learning problem provides a way forward by shifting the perception of implementation challenges from being simply negative to using these challenges as a diagnostic tool, or warning signal, about when, where, for whom, and why the implementation of CRSE is particularly difficult. Ultimately, research is needed to examine how each of the multilevel dimensions of the implementation of CRSE, either individually or in concert, constrains or promotes the implementation and spread of CRSE. This type of research would enable individuals, school leaders, and district- and state-level administrators to be more thoughtful about and plan more carefully the introduction and management of CRSE as an innovation.

Be iterative and inquiry-based, focused on making CRSE work in practice. Research should focus on working with educators to make CRSE work in practice. Too often, the focus of educational research is to learn whether a particular innovation works or not, leading to the premature abandonment of CRSE innovations if the research has not soon established a direct and empirical effect on standardized academic measures. Instead, research is needed that supports practitioners and gives them the necessary time to learn how to make CRSE innovations work for their students and in their specific contexts. The implementation of CRSE will take time and a culture that supports learning and innovation. Accordingly, research needs to be iterative and inquiry-based, supporting educators in a continuous process of designing and implementing CRSE instructional strategies; gathering and making inferences about practical forms of data and measurement that are relevant to the impact of these strategies on teaching and learning; and making iterative adjustments to their practice.

Be participatory, positioning researchers alongside, and honoring the expertise of, practitioners, students, community members, and families. Research should center the voices, experiences, and aspirations of students and their families and communities. How do the aspirations and experiences of students, their families, and their communities align or misalign with CRSE implementation? Do students feel that their identities are represented or that they can draw upon their funds of knowledge in their learning? How are the voices of students, families, and communities meaningfully incorporated into the design, implementation, and assessment of CSRE? Engaging in youth participatory action research is one way to both examine the implementation of CRSE and engage in a powerful pedagogical approach to support its implementation. Researchers should also center the voices and experiences of practitioners doing the work. What enables or constrains their willingness and ability to

implement CRSE? Which supports and resources do they need to adapt their practice? It is also important that researchers purposefully attend to their audiences, being aware of the needs and interests of practitioners, community members, families, and students. This attention should be taken into consideration when designing and executing research questions and methods, as well as when reporting and disseminating findings and recommendations. Reports and other publications should be written appropriately for each audience. For example, reports written for practice should be actionable and relevant to the local context.

Engage partners in collaborative sensemaking of data and evidence. Research should support the development of learning infrastructures in schools, districts, and state education agencies by engaging partners in collective sensemaking about data and evidence related to the implementation of CRSE. Doing so includes supporting practitioners in iterative learning around their collective understanding of how they are doing in relation to their CRSE goals. What are the challenges they are facing in the implementation of CRSE? And where are they being effective? How do they use this data and other evidence to problem-solve for specific issues and to spread good practices? And what does it take to turn this collaborative sensemaking process into standard work—that is, to sustainably integrate the process into the daily work of schools?

Seek out and engage with “bright spots” to learn from positive cases in which educators have made CRSE work. Research that documents the multilevel challenges that impede the implementation of CRSE is critical. However, research to identify and learn from educational contexts that have *effectively* implemented CRSE approaches is also essential. Educators report that one challenge they face in implementing CRSE is a lack of effective pedagogical models and instructional strategies (Neri et al., 2019). There are schools and districts across the country that are making CRSE work in practice. Research is needed that identifies and documents these “bright spots” to help spread effective approaches to implementing CRSE.

Detailing Data and Analytic Approaches for CRSE Research

Drawing from the epistemological and methodological stance articulated in this paper, the proposed research agenda prioritizes data collection and analytic approaches that center and support engaging in collaborative partnership and improvement efforts with educators and communities for advancing CRSE in mathematics classrooms, rather than prioritizing approaches that aim to generate new scholarly knowledge about whether CRSE works. Thus, future data collection and analytic approaches for engaging in research for advancing CRSE should be multifaceted and draw on both quantitative and qualitative data.

Research aimed at advancing and supporting CRSE implementation, locally and at scale, requires rich, qualitative data aimed at

- gaining insight into the experiences, needs, and aspirations of community members, families, students, and educators;
- learning about existing systems, structures, routines, and practices that constrain and enable the implementation of CRSE;
- learning from CRSE enactments across sites to understand how CRSE is performed moment-to-moment in classrooms, schools, and districts; and
- learning from iterative testing of strategies for supporting CRSE implementation.

A CRSE research program must attend to the interactions and lived experiences of participants and those most affected by the program to design and improve systems for implementing CRSE. Examples of qualitative data collection and analytic activities shaped by a practice-focused improvement research agenda include conducting and synthesizing empathy interviews to learn about the needs, experiences, and strengths of students and their families; observing both classroom and other school processes to understand how CRSE is enabled as well as constrained; and shadowing focal students and practitioners to better understand their

day-to-day lived experiences. These sorts of activities aim to bring teachers and school leaders in conversation and proximity with families and communities while generating scholarly and practical insight into the specific needs and experiences of those interested parties. Analytic activities that build on these interactions can also generate insight into how teachers and school leaders respond to and incorporate what they learn from these experiences.

A practice- and community-focused research agenda also requires attention to quantitative data that support practice improvement and are used in service of practitioners' learning. Drawing on improvement science (Bryk et al., 2015), this research agenda prioritizes quantitative data for improvement rather than prioritizing data to generate scholarly knowledge products. In this vein, quantitative data can

- shed light on trends and patterns among student, family, community, and educator experiences and perceptions (e.g. through surveys);
- indicate systemic structures, norms, and processes of CRSE implementation and their points of breakage;
- provide quick feedback loops on CRSE innovations and practices (i.e., practical measures) to see if the work is heading in the right direction; and
- serve as early indicators and precursors of the CRSE outcomes of interest.

These data must inform the day-to-day work of practitioners, support practitioner inquiry and reflection into their own practice, be accessible to practitioners, and be given to practitioners in a timely manner so that they can use these data. Improvement-focused quantitative data can enable practitioners at multiple levels—teachers, instructional coaches, school administrators, and district leaders—to see, at a glance, the experiences of students across settings and the extent to which CRSE implementation is enabling students to be culturally affirmed and to develop mathematical identities.

Researchers also need to closely engage families and communities in both qualitative and quantitative analytic activities. Measurement selection and design should be done in conjunction with marginalized students, families, and communities to center what they view as important, such that they can also be engaged in analytic activities once data have been collected. Takahashi and colleagues (2022) highlight the importance of measuring what matters in the context of improvement work. Students, families, and communities ought to be centrally engaged in deciding “what matters” and how to measure that so that their sensemaking of data

can be enabled and enhanced to guide CRSE implementation. Critically interrogating the power structures in education by using data enables these individuals and groups to have a voice in shaping CRSE going forward.

And finally, although there are critiques of focusing on dominant outcomes in mathematics learning and teaching (e.g., mathematical proficiency and mathematical achievement), as noted in this paper, these outcomes still hold currency in systems of schooling, including in how resources come to be allocated and in influencing communities' trust in schools. Thus, analytic activities that link CRSE implementation—including day-to-day routines, practices, and structures—to outcomes such as mathematical proficiency and achievement are also important. A research agenda around CRSE implementation in mathematics ought to be able to make the case for CRSE using these outcomes. The analytic activities linking CRSE to dominant and nondominant outcomes are important for building commitment to CRSE among a wide range of interested parties.

Charting Opportunities for CRSE Research

This research agenda highlights several multilevel barriers facing the implementation of CRSE at scale and with integrity (e.g., teacher disposition, prioritized outcomes, professional learning, district policy). These barriers signal critical opportunities for future research that can produce innovations in CRSE implementation. A central question for CRSE research is: How do CRSE enactments respond to and work toward eliminating these barriers? CRSE research ought to engage and address these barriers by positioning researchers alongside educators to generate innovations in implementing CRSE. For example, there is a need for CRSE research that documents efforts conducted with practitioners to implement sustained, systematic professional learning experiences. These experiences can help educators make connections between CRSE instructional practices and students' mathematical learning. Supporting educators in making these connections is important for shifting their value judgments of CRSE and improving how they implement CRSE in ways that enable student learning and develop students' positive mathematical identities. There is also a need for research that works alongside educators to develop practice-focused data systems and measurement tools that enable teachers and school leaders to review, reflect on, and improve their practice (Takahashi et al., 2022). Finally, research is needed that supports schools in building relationships with students, families, and communities that not only improve the quality of teaching and learning in schools and classrooms but also support students, families, and community members in their efforts to mobilize and act on their sociopolitical realities. As the evidence for CRSE grows, so, too, does the urgency to ensure systems of schooling are bringing high-quality CRSE implementation to more students, particularly Black, Brown, Indigenous, and other students from marginalized, nondominant communities.

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