But What Does it Look Like in Maths?:
A Framework for Culturally Sustaining Pedagogy in Mathematics

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ABSTRACT: In response to urgent calls for teaching that is culturally affirming, scholars have developed a myriad of images of culturally sustaining (and related) pedagogies (CSPs). However, for maths teachers, CSPs remain elusive, in part because these images are typically content-neutral and their applicability to practice opaque. In this paper, I synthesize research to help conceptualize and clarify what CSPs may look like specifically in mathematics classrooms. I offer a framework for CSPs in mathematics comprised of four dimensions: (1) anti-assimilationism, (2) strengths-based teaching, (3) power and justice, and (4) affirming identities.

KEYWORDS: Culturally sustaining pedagogy, mathematics education, professional development, teacher education, STEM

For decades, scholars have documented how racially-, linguistically-, or culturally-minoritized students can benefit from pedagogies that are culturally appropriate (Cazden & Legett, 1976; Jett, 2013; Torres-Velasquez & Lobo, 2005). From the inception of schooling in what is currently the U.S.[1] and in other settler-colonial states, schools have systematically worked to assimilate students who did not fit into the dominant culture. Some of the earliest compulsory schools in the Americas were designed with the explicit purpose of cultural genocide for Indigenous peoples (Lomawaima & Ostler, 2018) and Lomawaima and McCarty (2006) described the choice "to remain an Indian" against the pressures of schooling "an essential human right" (p. xxii). This assimilatory press of schooling did not end in some distant past (Davila & de Bradley, 2010; Putnam et al., 2011),

nor is it reserved only for Indigenous students; across the U.S., schools still explicitly privilege "academic" English and passively elide non-European contributions, epistemologies, and values (Lees et al., 2021; Martinez et al., 2016). For example, teachers are often taught that supporting multilingual students means helping them leave their heritage languages behind to acquire academic English (Alim & Paris, 2017), and some schools have English-only policies even in school hallways (López, 2002). Scholars have documented other ways that students are divested of their cultures: Black students' hair and language patterns are policed as "unprofessional" (Morris, 2016) and students' clothing, too, is often treated as something to correct, all under the guise of preparing students for future success (Wynter-Hoyte et al., 2021).

Against this backdrop, calls for teaching that is culturally sustaining ring strong and clear from research, theory, and practice. Recognizing that schools often function to pathologize, marginalize, and assimilate minoritized students (Ladson-Billings, 2009; Martin, 2013; Paris & Alim, 2017), scholars have developed many images of asset-based forms of teaching, such as culturally-relevant (Ladson-Billings, 1995b), culturally-responsive (e.g., Cazden & Legett, 1976; Gay, 2000; Pewewardy, 1994), and culturally-sustaining (e.g., McCarty & Lee, 2015; Paris, 2012; Paris & Alim, 2014, 2017) pedagogies.

Despite the existence of these myriad images of culturally sustaining pedagogies (CSPs), there remains a sizeable theory-practice gap; teachers lament that understanding precisely *how* to teach in these ways remains elusive (Grant & Gillette, 2006; T. O. Jackson et al., 2021; Ukpokodu, 2011). Culturally-responsive or sustaining pedagogies largely remain peripheral — sometimes even optional — in teacher preparation programs (Allen et al., 2017), often siloed in just one course (Hernandez et al., 2013). Moreover, images of CSPs in teacher preparation programs are generally content-neutral, rendering them intangible and opaque for mathematics teachers (Aguirre & Zavala, 2013; Leonard et al., 2010; Ukpokodu, 2011). Although literacy and social studies fields have made strides to recognize and address the need for CSPs (e.g., Irizarry, 2017; Ladson-Billings, 2001), mathematics remains widely viewed as culture-free (Boutte & Kelly-Jackson, 2010; Shah, 2017). Across the field of mathematics education, goals such as development of a maths-proficient workforce for national defense are often at odds with goals like creating more just learning experiences for marginalized students (Valero & Knijnik, 2015; Wolfmeyer, 2013). Many mathematics teachers view culturally-focused maths as "too much of a conceptual and substantive stretch for their subjects to maintain disciplinary integrity" (Gay, 2002, p. 107). Even when teachers recognize mathematics as cultural and racial projects (D'Ambrosio, 1997; Martin, 2013), secondary maths teachers pursuing CSPs must look outside their content and contexts for resources, which can be superficial and fragmented (Kea & Trent, 2013).

To address this problem, I synthesize a wealth of theoretical and empirical work that helps the field conceptualize and clarify what culturally-responsive and culturally-sustaining teaching can look like in mathematics. From this work, I devise

a framework for culturally sustaining pedagogies in mathematics. Finally, I discuss the scope and utility of this framework in teacher development.

The Foundations of Culturally Sustaining Pedagogies

For decades, scholars have called for greater alignment between teaching and students' home lives. For some, such efforts aim to relate content to racially-minoritized students' cultures (Nieto, 1994), such as representations in curricula (Banks & Banks, 1995; Lopez, 2015). Others call for more culturally congruent interactions and participation structures (e.g., Jordan, 1985). As Ladson-Billings (1995a) points out, however, this work sometimes tended to emphasize *accommodation*, or providing a bridge to help students adapt to and eventually join mainstream culture (Szech, 2022). Often, cultural congruence has been couched in terms of supporting "achievement," its value deriving from its potential to raise students' test scores rather than to provide education that is wholesome or affirming for minoritized students (Banks, 2009; Horton, 2022; Howard & Rodriguez-Minkoff, 2017; Sampson & Garrison-Wade, 2011; Sleeter, 2012).

Ladson-Billings (1995b) advanced this work substantially with her theory of *culturally relevant pedagogy*. Culturally relevant pedagogy "not only addresses student achievement but also helps students to accept and affirm their cultural identity while developing critical perspectives that challenge inequities that schools (and other institutions) perpetuate" (p. 469). Situating her work in Black feminist thought (Hill Collins, 2009), Ladson-Billings envisions a pedagogy that holds high standards, is asset-oriented, develops a collaborative community of learners, maintains students' cultural integrity, and views knowledge critically, as shared and constructed. However, since its introduction, culturally relevant pedagogy has been used reductively in many cases, with teachers trivializing and essentializing students' identities (Sleeter, 2012; Ukpokodu, 2011) and distilling an ethical stance instead into a recipe that does not resemble Ladson-Billings' original call (Allen et al., 2017).

In an effort to reframe pedagogy and curriculum from *relevant to* students' home lives toward pedagogy and curriculum that is *designed for* culturally-minoritized students, scholars later embraced Cazden's and Legett's (1976) term *culturally responsive pedagogy* (e.g., Gay, 2000; Villegas & Lucas, 2002). Gay identified six characteristics of culturally responsive teaching: (1) it is validating, teaching to and through students' strengths; (2) it is comprehensive, teaching the whole student; (3) it is multidimensional, tapping into varying perspectives and experiences; (4) it is empowering, helping students become more successful learners and participants in society; (5) it is transformative, preparing students with the cultural consciousness to transform society; (6) it is emancipatory, challenging mainstream canons of knowledge and freeing students' minds (see also Pewewardy, 1994). This work dovetails with Ladson-Billings' (1995b) theory, and both have been highly influential in the field of education (Bergeron, 2008; Howard & Rodriguez-Minkoff, 2017).

In this article, I use the term *culturally sustaining pedagogies* as an umbrella term because it encompasses and extends this prior scholarship (Flint et al., 2021). As Paris (2012) acknowledges, this term builds on decades of visionary work, but he wonders "if the terms 'relevant' and 'responsive'… go far enough in their orientation to the languages and literacies and other cultural practices of communities marginalized by systemic inequalities" (p. 93). Although Ladson-Billings (1995b), Gay (2000), and others called for more than bridges to help minoritized students step into dominant culture, their work was often taken up in superficial and even harmful ways (Brayboy & Castagno, 2009; Paris, 2012). Paris elaborates,

> Relevance and responsiveness do not guarantee in stance or meaning that one goal of an educational program is to maintain heritage ways and to value cultural and linguistic sharing across difference, to sustain and support bi- and multilingualism and bi- and multiculturalism. They do not explicitly enough support the *linguistic and cultural dexterity and plurality* (Paris, 2009, 2011) necessary for success and access in our demographically changing U.S. and global schools and communities. (P. 95)

Although CSPs still hold access to dominant culture as a goal, this goal does not take precedence over the goal of supporting and maintaining students' and communities' own cultures. They imagine pedagogies that might exist out from under the dominance of the white gaze — pedagogies that care for and provide for students' cultural ways of being and doing.

Although CSPs have been well-articulated theoretically, what they look like in various content areas is still in the nascent stages of development. In a recent volume on CSPs (Paris & Alim, 2017), San Pedro (2017) argued that the opportunity to draw and write their own stories validated for Indigenous students "who we are and who we are becoming" (p. 113; see also Nguyen, 2022). In the same volume, Kinloch (2017) showed that Black students' ways of being in schools have often been so devalued that it is necessary to invite students to resist and reject educational approaches that undermine their literacies and identities (see also Caraballo, 2017), instead co-constructing literacy learning experiences. Also advocating co-constructed learning spaces, Irizarry (2017) argued that "when positioned as teachers and allowed to shape the classroom culture and climate, develop curricula, and take responsibility for its implementation" (p. 94), students in their study developed critical consciousness and were able to challenge marginalizing practices in their school and "assert agency over their own educational trajectories" (p. 96). Turning to students' heritage language, Bucholtz et al. (2017) focus on language as sustenance, advocating translanguaging pedagogy (García & Li, 2014)–a pedagogy that deliberately supports students' use of their full linguistic repertoire as they learn, rather than elevating English in the classroom (see also Cantu, 2022). The importance of this is underscored by Lee and McCarty (2017), who argue that teaching Native students their Native languages can foster access to their communities' knowledges and strengthen tribal sovereignty. Overall, the majority of this work centers literacy practices (Ortiz

& Ruwe, 2021), showing that CSPs can affirm students' identities and cultural practices, while working against oppression.

In addition to these examples from literacy and art classrooms, Paris (2021) outlines some key features that have emerged across this work: First, "a critical centering" (p. 367) of communities, along with their languages, practices, and knowledges (see also Gilblom et al., 2022); second, honoring students' and other generations of the communities' agency as genuine collaborators in learning; third, efforts to be in "good relationship with the land, the people of the land, with students and communities" (p. 367), which requires reciprocal relationships and genuine decolonial work (Eagle Shield et al., 2020; Lee & McCarty, 2017); and fourth, "critically assess[ing] what to center and sustain" (p. 367) in partnership with communities. These principles are crucial, yet we have only begun to scratch the surface of what CSPs may look like in practice.

Culturally sustaining pedagogies ultimately seek to nurture and sustain minoritized students' whole selves, supporting students to honor, advance, and sometimes problematize their and their communities' cultural practices (Paris & Alim, 2014). CSPs do include a commitment to students' academic development (Gay, 2000; Ladson-Billings, 1995b), with the recognition that "current measures of achievement are narrow and assimilative and so not the sole goal" (Paris, 2016, p. 8). CSPs also pursue students' development of sociopolitical consciousness and agency (Ladson-Billings, 1995b), simultaneously fostering both access and dissent (Morrell, 2004). Importantly, CSPs cannot be standardized into a set of practices (Paris, 2016); they must respond to students' unique cultural and mathematical learning experiences (Ladson-Billings, 2017).

Conceptualizing Culture

In order to develop CSPs, it is important to unpack culture as a construct. Scholars have lamented that, again and again, efforts to create culturally relevant or responsive approaches have involved narrow, static, or even harmful notions about minoritized students' cultures (Brayboy & Castagno, 2009; Ukpokodu, 2011). In part, this is because culture and race or ethnicity are commonly conflated (Artiles et al., 2011). Culture is often operationalized as group traits, inviting essentialization and homogenization by teachers who are often cultural outsiders to their students (Artiles et al., 2011; Waitoller, 2014). There are several harmful consequences of this. For example, Artiles and colleagues (2011) point out that this sometimes results in educational approaches based on presumed cultural codes, such as learning styles — a largely debunked, reductive interpretation of cultural participation patterns (Furey, 2020). Group-membership-based notions of culture also assume homogeneity (Artiles et al., 2010), overlooking within-group and even within-individual diversity (Anzaldúa, 1999). In short, these common conceptions of culture can lead teachers to rely on cultural representations that are superficial, contrived, or even caricatures, doing more harm than good.

Culturally sustaining efforts have sometimes privileged students' heritage cultures, fixing notions of culture in the past and ignoring the ever-evolving nature of culture. As Bang (2015) points out, culture is not static; it is continually "constructed in dynamic activity" (p. 222). As an example, Artiles (2003) asks us to consider Latin*s[2], who are often portrayed as having a shared, fixed culture. This portrayal predominates, despite that Latin American countries each have unique histories and cultures, and each individual within a certain country belongs to specific, local communities with distinct cultural codes as well. Moreover,

> when Latinos/as who have lived for generations under these conditions migrate to the United States, they engage in a complex process of coping and adapting to the host society that is inextricably intertwined with the cultural histories crafted in their homelands. Meanwhile, let us not forget that the cultural history of the dominant U.S. society has also influenced the evolving cultural histories of Latinos/as. (p. 185)

Indeed, culture is constructed amid these "historical residues" (Artiles, 2003, p. 182) and in coordinated social activity in specific contexts. Paris and Alim (2014) are clear that culturally sustaining pedagogies must not be based on monolithic, static, historicized, or idealized notions of culture. "It is crucial," they write, "that we understand the ways young people are enacting race, ethnicity, language, literacy, and cultural practices in both traditional and evolving ways" (p. 90). Paris and Alim call for pedagogies to "address the well-understood fact that what it means to be African American or Latina/o or Navajo is continuing to shift in the ways culture always has" (p. 91).

Culture is also power-laden (Eisenhart, 2001). Dominant culture, Artiles (2003) explains, "is naturalized and used as a reference point against which all other cultural practices are compared and evaluated" (p. 186). Some cultural practices are deemed more acceptable by dominant society, while others are pathologized. Thus, when working to create culturally sustaining educational experiences, teachers may be working against widespread deficit notions about the very cultures they intend to sustain, notions they may not even be aware of having internalized.

Moving away from culture as a proxy for race or ethnicity also allows for the recognition that humans belong to multiple cultures concurrently. Cultures cannot only be distinguished on gigantic hemispheric levels (e.g., Western culture), but also tiny idiocultures (Fine, 1979); for example, within a certain school, there is a culture of celebrating seniors as they put together capstone research projects. As one commonly overlooked example, Waitoller (2014) suggests that "disability culture should be recognized as one of the many dynamic cultures in pluralistic societies" (p. 69, citing Vasey, 1989). In thinking about culturally sustaining pedagogies, teachers must consider the multiple cultural repertoires with which students engage and consider the intersectional nature of their cultural participation (Crenshaw, 1994; Hill Collins, 2009).

Thus, when designing learning environments for teachers to support culturally sustaining pedagogies, it is important to work toward such expansive

views of culture. Teachers need to understand culture as complex, dynamic, and multi-dimensional, as well as to understand its relationship to systems of power and oppression. Culture is not static, nor is it a proxy for race; it is constantly in flux and being socially produced by students with their (multiple) communities, in interaction with both local forces and larger societal forces of power, politics, and racialization.

A Framework for Culturally Sustaining Pedagogies in Mathematics

Given the complexity of this work and the dearth of support in teacher preparation programs (Allen et al., 2017; Hernandez et al., 2013), it is small wonder that teachers feel ill-prepared to teach in culturally responsive or sustaining ways (Grant & Gillette, 2006; Ukpokodu, 2011). To make CSPs more tangible for mathematics teachers, I developed a framework intended to be accessible to maths teachers in a variety of settings. This framework builds on the work on CSPs in other content areas, the emergent principles for CSPs shared by Paris (2021), and the rich scholarship in mathematics education related to multicultural education. The four dimensions (not ordered by importance) are: (1) anti-assimilationism; (2) strengths-based teaching; (3) power and justice; and (4) affirming identities (Figure 1).

Figure 1

A Framework for Culturally Sustaining Pedagogy in Mathematics
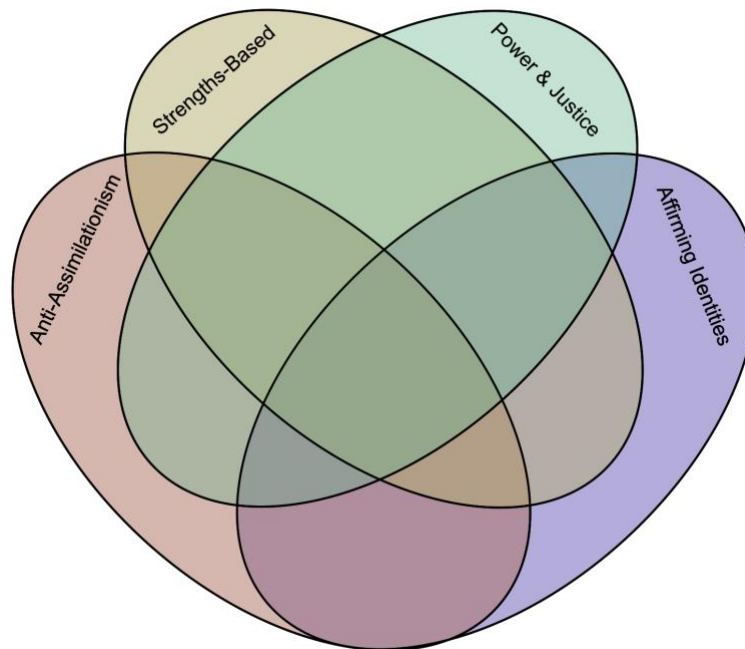
Anti-Assimilationism

One element that distinguishes CSPs from their culturally-relevant and culturally-responsive predecessors is an explicitly *anti-assimilationist* stance. Across the U.S., schools often require students to leave their identities, communities, cultures, and languages behind in order to be considered successful (Irvine, 1990; Tsinnajinnie, 2018). Schools still explicitly reward "academic" (i.e., dominant/white) English (Alim & Paris, 2017; López, 2002) and white, middle-class demeanors, ways of learning, and even clothing and hair styles.

Because eradication of non-dominant languages has been such a central piece of school-based assimilation efforts (Lee & McCarty, 2017; Marshall, 2018; Ruef et al., 2020), language deserves a central place in CSPs (Michener et al., 2015), even in mathematics. CSPs have an ultimate aim of supporting students in developing "full blown" (Ricento, 2005, p. 361) multilingualism, rather than acquiring academic English at the expense of their heritage languages (Ryan & Parra, 2019). Taking this dimension seriously may mean learning to support students in making sense of mathematics in their home languages or by translanguaging (Bucholtz et al., 2017; Esquinca, 2011), as well as inviting and celebrating marginalized forms of expression in maths classrooms. These are pedagogical approaches that most mathematics teachers receive little or no support in (Marshall et al., in press). Although students' linguistic practices are often viewed as a barrier to their participation in mathematics (Marshall et al., in press), supporting multilingual learners' use of a full spectrum of their linguistic resources (Bucholtz et al., 2017; Esquinca, 2011) and deliberately welcoming marginalized forms of expression (Gardner et al., 2021) can be important approaches for anti-assimilationism.

It is important to note that this marginalization of students' habitual communication patterns does not only happen with students officially classified as multilingual; speakers of Black language (Baker-Bell, 2020) and other disparaged ways of speaking are frequently taught—both explicitly and implicitly—that they should adopt dominant/white speaking habits (Baker-Bell et al., 2017; Boutte et al., 2021; Ortiz & Ruwe, 2021). In fact, many assimilationist policies in U.S. schools have anti-Blackness at their core (Boutte et al., 2021). Boutte and colleagues describe "*linguistic violence* as a form of hostility that marginalizes, negatively profiles, and polices the language of Black youth through privileging and promoting" (p. 232) white mainstream English, leading too often to shame and internalization of negative ideas about their ways of speaking (Baker-Bell, 2013). To redress this, teachers must interrogate the expectations they hold and the subtle and overt signals that they send about appropriate ways of participating in mathematical discourse.

The anti-assimilationism dimension also calls teachers to recognize that students often access advanced mathematics through teacher recommendation, and such recommendation is subject to teacher biases (Copur-Gencturk et al., 2019). These biases may not only be affected by students' use of dominant,

mainstream English (Boutte et al., 2021; Campbell, 2012) but also their assimilation into mainstream participation patterns, such as individualism and competitiveness (Brayboy, 2005; Gay & Howard, 2000), rather than their propensity for or facility with mathematical ideas (Campbell, 2012). As Agarwal and Sengupta-Irving (2019) point out, learning "often reflect[s] assimilation or erasure of epistemic agency of minoritized people to know and do the disciplines in favor of western epistemologies" (p. 351, citing Bang & Vossoughi, 2016; Gutiérrez, 2017; Gutstein, 2006; Martin, 2013). To redress such erasure, anti-assimilationism includes first recognizing these western epistemologies in mathematics, then working to align classroom practices and values with students' practices and values (McCarty et al., 2015) as much as possible. One way to do this might be inviting students to participate in setting classroom and discussion norms.

Overall, an anti-assimilationist stance means ensuring that students do not have to forsake their cultures, languages, practices, or ways of being — in other words, to become someone else — to be successful in mathematics (Kokka, 2015). For example, Rivera and colleagues (2023) found that teachers' use of Black language in the classroom could be a powerful tool for cultural sustenance; by rejecting dominant notions of "proper" (i.e., white) academic ways of speaking, these teachers used Black language to encourage Black students' authenticity and participation, and to subvert the typical marginalization of their students' habitual ways of speaking (see also Charity Hudley & Mallinson, 2017). To work toward anti-assimilationism, teachers must interrogate their biases and expectations with regard to language use in the classroom, the forms of student expression they accept and invite, ways of participating in mathematics, and even their adherence to school policies that may be assimilatory. Teachers must ask themselves the extent to which success in their classes is dependent on "compliance," "good behavior" (Tsinnajinnie, 2018), or authentic mathematical engagement (Marshall et al., in press). Even what counts as disciplinary engagement might be critically examined. For example, Agarwal and Sengupta-Irving (2019) highlight ways to honor epistemic diversity, historicity, and identity in what counts as doing mathematics. It may be helpful to regularly take stock of the policies and expectations in one's classroom, asking whether they implicitly or explicitly expect students to suppress or leave behind any part of who they are and, furthermore, whether they could better design the learning environment so that students' whole selves are not merely allowed, but welcomed and celebrated.

Strengths-based Teaching

In conceptualizing the *strengths-based* dimension of CSPs, I drew on a wealth of asset-based literature about building on students' and communities' knowledges, practices, languages, assets, and commitments (Civil, 2007; Gay, 2000; Kokka, 2015; Yazzie-Mintz, 2007). These forms of teaching include intentionally building on students' mathematical ideas (Wachira & Mburu, 2017),

as well as their home knowledge and practices (Aguirre & Zavala, 2013; Civil, 2007; González et al., 2001; Moll et al., 1992), such as through connecting learning experiences and content with ideas that have significance and importance to students' lives, as well as to their personal commitments and beliefs.

Some of the most well-known research on strengths-based teaching in mathematics is work on "funds of knowledge" (Aguirre et al., 2013; Civil, 2007; González et al., 2001; Moll et al., 1992; Turner et al., 2009). This work aims to help teachers draw on students' home and community knowledge and experiences, building on these in mathematics classrooms (Flint & Jaggers, 2021). Moll and colleagues describe studying how families go about their day-to-day life, taking note of the expertise, skills, morals and ethics that they exhibit. In these concerted efforts to volte-face deficit perspectives of students of color, the authors advocate that teachers themselves conduct such research, then build on these insights to construct mathematical learning experiences for students based on what students know and are familiar with, as well as what they care about (see also Aguirre & Zavala, 2013). Bullock and Meiners (2019) elaborate, "Non-elite mathematics practices that support communities' basic daily needs exist alongside school-endorsed mathematics, so honoring various layers of — and approaches to — mathematical knowledge can restore dignity and improve learning outcomes" (p. 343).

In order to teach in strengths-based ways, it is critical to intentionally get to know students, families, and communities (Flores & Springer, 2021; Milner, 2006; Moll et al., 1992). Aronson (2008) calls teachers to "cultivate a mindset of insatiable curiosity about… students as individuals: who they are, the experiences they have had, what they think about things, and how they think" (p. 67). To make learning experiences meaningful for students, teachers must become students of the communities in which they work (Katsarou et al., 2010), asking themselves, *What do my students' families value? What are the strengths of these communities? What are activists in the community working toward?* Importantly, this work requires humility and genuine relationship-building, as well as reciprocity in the community. Getting a pulse on the community's strengths can help teachers build on these strengths in meaningful ways in mathematics classrooms.

This dimension also includes honoring varied approaches to mathematics. Students from various cultural backgrounds may bring algorithms or approaches that do not fit the dominant mathematical canon (e.g., Aguirre, 2015; Gutiérrez, 2015), and teachers must hold space for students to invent and share varied solution approaches. Students bring many valid ideas about mathematics that can easily be dismissed if they do not meet commonly-held conceptions about the way a certain mathematical task is performed; therefore, this dimension emphasizes providing space for students' ideas to be encouraged, shared, affirmed, and built upon (Turner & Strawhun, 2007). This kind of teaching represents a departure from the norm (Jacobs et al., 2007), and is not easy in mathematics. It requires teachers to not only listen a great deal more to students' mathematical ideas, but also to craft lessons and tasks that make space for students' ideas to be heard, as well as

to develop facilitation skills to encourage the sharing, hearing, and building of ideas.

Strengths-based teaching can also include students and communities shaping curriculum and learning environments. One principle for avoiding essentializing students' cultures — a common phenomenon in initial attempts to teach in culturally relevant ways (Waitoller, 2014) — is to redesign mathematics curricula to be more student-driven, allowing students to shape connections, inquire into their worlds and communities (Jones, 2015; Matthews et al., 2013), and choose topics that are meaningful to them (Turner et al., 2009; Wachira & Mburu, 2017). This principle aims to tap the strength of students' passions, activism, creativity, and more (Reyhner et al., 2011) for mathematizing the world around them.

It is important for teachers to deliberately take stock of their students' strengths as they design learning environments and experiences in mathematics. It is impossible to teach to students' strengths using some generalized "best practices;" instead, teachers must deeply work to learn not only their students' strengths but also those of the communities from which their students hail. One exercise worth undertaking might be sitting down with the roster and naming a strength for each and every student. Importantly, though, this should not solely rely on the teachers' perceptions of students' strengths; these may differ from what students themselves see as their strengths, so engaging students and families in the work of identifying and recognizing their strengths — both within and outside of mathematics — may be an important part of this work. Once some strengths have been recognized, teachers might then ask themselves how to ensure that their classrooms allow these strengths to shine.

Power and Justice

Another dimension of culturally sustaining pedagogies is issues of *power and justice*. Students are culturally-, linguistically-, and racially-marginalized not by chance but by systems of power. For teachers to work toward cultural sustenance, they must not only gain understanding of these systems of oppression and injustice (Hart, 2016), but also how to work against these systems themselves, and how to support students in countering them. This dimension includes anti-racist teaching (Pollock, 2008; Troyna, 1987), as well as using mathematics to both understand and combat oppression (Berry et al., 2020; Frankenstein, 1983; Gutstein, 2003; Skovsmose, 2000).

Anti-racist teaching is crucial in CSPs. Nieto (2008) points out that caring for students and wanting to support their cultural development is insufficient; if teachers fail "to counter a social structure that treats them unequally" (p. 29), they harm students with their passivity. Working toward CSPs means not only interpersonal anti-racist work, but also systemic. This can include uncovering racial patterns in the ways in which students are tracked in mathematics and

interrogating teachers' own roles in such patterns (Copur-Gencturk et al., 2019) and scrutinizing (both school-wide and individual) in-classroom behavioral expectations and punishment practices for racial bias (Bullock & Meiners, 2019; Morris, 2016; Noguera, 2008). Moreover, teachers must consider the ways in which mathematics itself confers power and is used as a gatekeeping tool that functions to maintain the status quo for those in power (Bullock & Meiners, 2019; Larnell et al., 2016).

Cultural sustenance also requires making way for students' agency and desires, and deliberately ceding power. This can be difficult for teachers who believe they have students' best interests at heart but may be foisting their own definitions of success and achievement onto students and communities (Freire, 2005). Nieto (2008) highlights that "we ask [students] to sit quietly and we tell them what's important… and we never ask them who they are and where they want to go" (p. 29). The power and justice dimension seeks to remind teachers that they are in positions of tremendous power, and to critically examine the ways that they use it.

Another way in which power and justice can be addressed is through curricula that use mathematics to investigate and combat oppression. Ladson-Billings (2014) commented that, in many cases when teachers took up culturally relevant pedagogy superficially, "they rarely pushed students to consider critical perspectives on policies and practices that may have direct impact on their lives and communities" (p. 78). Instead, she insisted, we must expect marginalized students "to be raising the critical questions and pushing the discourse" (p. 80). In using mathematics to develop students' sociopolitical awareness and agency (Evans & Staples, 2022; Frankenstein, 1983; Kokka, 2018; Larnell et al., 2016), CSPs expose mathematics as cultural tools, created for humans and by humans, often for political purposes (D'Ambrosio, 1997). Thus, this power and justice dimension also includes using mathematics as tools to critically challenge injustices faced by students and their communities (Gutstein, 2006). As Gutstein points out, equity in mathematics education tends to focus on what happens within classrooms, overlooking "the position that society must be thoroughly restructured and that mathematics is a vehicle *through* which to accomplish this" (p. 13). Gutstein urges this kind of teaching to help students better understand the conditions in which they live and the ways in which they can engage in social movements using mathematics. Importantly, teaching mathematics for social justice can help students develop agency and more positive cultural identities (see also Kokka, 2018).

Overall, if mathematics teachers want to create learning environments that sustain students' cultures, they must consider the roles of power and justice. This includes their own power in the classroom and school, as well as how they might empower students through their teaching and content (Picower, 2012). It also includes using mathematics as a tool to help students better understand injustice as well as preparing them to combat such injustice through mathematics.

Affirming Identities

The final dimension of the framework is *affirming identities.* A sobering question by Malone (2019) highlights the importance of this dimension: "By 3rd grade, I felt ashamed because my schooling rarely connected with my identity. What would it have been like to feel recognized and valued the moment I entered school? Is this not what all children deserve" (para. 17)? *Affirming identities* therefore includes not just affirming students' mathematical identities, cultural identities, and other important facets of who they are; it also includes ensuring that students feel recognized, seen, and valued in schools.

Affirming students' mathematical identities can include recognizing nondominant forms of competence in mathematics (DeFino, 2019; Hand, 2012; Louie, 2017). For example, Horn (2014) describes ways to expand what it means to be smart in mathematics, pointing out that in many schools, "the most valued kind of mathematical competence is typically quick and accurate calculation" (para. 4). She instead suggests privileging competencies such as posing interesting questions, making connections, representing ideas clearly, developing logical explanations, working systematically, and extending ideas, noting that these "broader notions of mathematical competence are actually more authentic to the subject" (para. 5). To achieve a similar aim, a teacher in DeFino's study made sure to use "mathematical tasks with multiple entry points" (p. 235), including those with many solutions, as well as those that construct "sound mathematical explanations over finding correct answers" (p. 235; see also Boaler & Staples, 2008). Broadening what counts as mathematics and what counts as mathematically smart can help cultivate mathematical identities in students, an important endeavor because schools have often been the primary place where students' maths identities are dismembered (Chen, 2020; L. Jackson et al., 2021).

To affirm identities, teachers must also examine *how* students' mathematical identities are (re)constructed interactionally in the classroom (Boaler & Greeno, 2000; Flint & Jaggers, 2021; Marshall, 2020). A teacher might audit how, when, and whom they revoice during whole-group discussions, to think about what this teacher move does to position students as mathematicians or otherwise in their class (Turner et al., 2013). The teacher in DeFino's (2019) study also prioritized repositioning students who had, in the past, been positioned as less mathematically capable. She deliberately positioned them as making important mathematical contributions through public statements like, "What you said was really important and I want to make sure everyone hears it" (p. 235). Similarly, taking note of who does the intellectual heavy lifting, both in small groups and in whole-class discourse, can help teachers make sure minoritized students are supported in mathematical-knowledge-creating roles (Aguirre & Zavala, 2013; Boaler & Greeno, 2000; Marshall, 2020).

Steps toward affirming students' racial and cultural identities can include simple changes, like ensuring curricula and posters on the walls represent a diverse range of people (Hart, 2016; Pollock, 2008) and highlighting the

mathematical contributions of students' communities and ancestors (D'Ambrosio, 1997; Powell & Frankenstein, 1997), but may also require deeper changes, such as epistemic shifts that "consider how schools mathematize one reality, and how various groups mathematize their own realities in other, *equally valid ways*" (Bullock & Meiners, 2019, p. 343, emphasis added). Indeed, it is important for students to have opportunities to see their cultural communities as significant sources of knowledge in mathematics (Ladson-Billings, 1995a; Murrell, 1994); but, far too commonly, when mathematicians are celebrated, it is Europeans' contributions that take center stage (Marshall, 2018; Powell & Frankenstein, 1997; Tate, 1995).

Celebrating students' racial and cultural identities can also include making space for students' cultural expressions (Tyler et al., 2006) as they participate in mathematics in the classroom. For example, Gardner and colleagues (2021) describe a regime of "racialized emotion" in schools, where students' natural, spontaneous emotional expressions are often disciplined and "cultural expressions of creativity and joy such as 'beatboxing, or drumming are characterized as disruptive rather than poetic celebrations of the here and now'" (p. 306, citing, Garza, 2020). Teachers can move toward affirming students' identities (and making maths classrooms more joyful spaces by making it clear that such expressions are welcome.

In sum, this dimension includes clearly confirming that students belong in mathematics *just as they are* (Aguirre et al., 2013). This can be accomplished through approaches like affirming students' mathematical identities (AMTE, 2017), celebrating their racial and cultural identities (Braden & Gibson, 2021), positioning students as mathematics knowledge-creators (Banks & Banks, 1995; Cobb et al., 2009; DeFino, 2019; Lampert, 1990), and highlighting the multicultural roots of mathematics (D'Ambrosio, 1997). It may be helpful for teachers to ask themselves how their students' community mathematical practices are represented in the classroom, which students seem most often viewed as mathematically competent, and how students can be positioned as mathematical contributors.

Conclusion

When Paris (2012) issued his call for culturally sustaining pedagogies, it immediately struck a chord across the field of education. Scholars have taken up these ideas in literacy education (e.g., Braden & Gibson, 2021; Bucholtz et al., 2017; Flores & Springer, 2021), social studies education (e.g., Martell & Stevens, 2019), arts education (e.g., Wong & Peña, 2017), and special education (e.g., Grier-Reed & Williams-Wengerd, 2018), beginning to bring the theory to life across various domains. However, we still do not yet have solid portraits of what CSPs can look like in mathematics. One reason is that many still view mathematics as a field that is acultural (Shah, 2017) and apolitical, despite that mathematics is a subject that stratifies students by race (Martin, 2013) and often rewards students' adherence to white cultural norms (Brayboy, 2005; Flint & Jaggers, 2021). This

framework represents an initial offering for fleshing out what CSPs may mean in mathematics.

Looking back at Figure 1, it is important to note that this four-way Venn diagram leaves numerous possible spaces for teachers to work in. This was deliberate; it is highly unlikely that teachers' work will always be in the middle, considering all four dimensions of CSPs in mathematics at once. Instead, this figure emphasizes that teachers may enact these dimensions of CSPs in a multitude of ways. Focusing on one or two dimensions at a time may support more meaningful change than attempting to overhaul all their instruction at once. Moreover, it may not always be clear which specific dimension a particular teaching approach fits. For example, making space for non-dominant forms of mathematics might fit in the *affirming identities* dimension, when a teacher is working to emphasize that many approaches to mathematics are valid and one does not need to adhere to canonical algorithms, but this may also fit in the *strengths-based teaching* dimension, when a teacher is thinking especially about building on what students already know. Indeed, others have noted that asset-based approaches to maths teaching contain considerable overlap (e.g., equitablemath.org). My hope is that these four dimensions provide some useful lenses for thinking about CSPs and mathematics teaching in practice.

Although these four dimensions are intended to be a framework for thinking about what CSPs can look like in mathematics, they are not intended to represent discrete "best" practices (Ladson-Billings, 2017) or to be authoritative or canonical; CSPs may take many forms that are not covered by this framework. Rather, they are meant to provide lenses for thinking about mathematics teaching. This work builds on scholarship in culturally relevant and responsive pedagogies, as well as other asset-based education scholarship, but as the field elaborates on CSPs, it is my hope that our portraits of CSPs in mathematics may evolve and become more robust as well.

Finally, with this framework, I hope to emphasize that CSPs should not be based on static, historical, or monolithic notions of culture. By highlighting the deliberate work of teachers getting to know their students and their families, as well as inviting students to co-design learning environments and experiences, this framework aims to allow for cultural sustenance to take on a more dynamic character. These dimensions can provide teachers with questions and frames for making their pedagogies more culturally sustaining in their own unique but ever-changing contexts, with their particular students.

Notes

1. Following Professor Lee, I use the phrase "in what is currently the U.S." to "open possibilities for imagining futurities beyond the settler state" (damienlee, 2018; see also Lee, 2017).

2. Because "Latinx" has been taken up problematically and primarily in academia rather than in Latin* communities, I follow Salinas (2020) in using the term "Latin*" to signify inclusivity of fluid gender and social identities.

Acknowledgements

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