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# Mathematical Identity: Creating PK-12 Mathematics Environments of Inclusion, Representation, and Belonging

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*This article explores practical opportunities for K-12 students to engage authentically with mathematics, develop their mathematical identities, and celebrate the diverse aspects often overlooked in the field. We highlight and honor the diversity in mathematics while investigating significant teacher practices that engage students in a welcoming mathematics learning environment, providing a sense of belonging. The experiences discussed enable students to link their mathematical identity to the remarkable contributions from their own cultures, fostering a sense of belonging.*

***Keywords****:* mathematical identity, inclusive practices, relationality, funds of knowledge

In preparation for this article, we asked five teacher friends to define *inclusion*. All immediately responded with technical definitions that, in a nutshell, centered around special education and language associated with the Individuals with Disabilities Education Act (IDEA). So, we returned to the drawing board and posed the same question to five friends who were not educators, just everyday people not associated with careers in education. Interestingly, these friends instinctively changed the term from *inclusion* to included, emphasizing a need to belong or feel a sense of belonging. To them, being included simply meant being welcomed and actively involved in whatever activity they were invited to participate in.

Many educators are conditioned—cue Pavlov, to respond based on what we have been explicitly taught, often in isolation. We intuitively lean into what has been emphasized in our teacher preparation programs or professional development sessions. Meanwhile, regular folks take a more human-centered approach. This microscopic lens we operate from can be to our detriment. It limits our perspective and, ultimately, stifles the joy of learning for all students.

We become so fixated on compliance or technicalities that we overlook how today's children learn—and in doing so, we fail to meet them where they are.

## Connecting Data to Inclusion

How often do we hear that "mathematics is a universal language"? However, here in the United States, we continue to see a decline in student achievement in mathematics. According to the 2023 Trends in International Mathematics and Science Study (TIMSS), average mathematics scores for U.S. fourth graders dropped by 18 points, and eighth graders saw a 27-point decline compared to 2019. These declines have returned U.S. students' performance to levels last seen in 1995, erasing decades of progress.

Which students are truly included in this so-called universal language, and who is still waiting for an invitation to engage and achieve in mathematics? This article explores how inclusive practices can positively shape mathematics education. We examine how small, intentional, and practical curriculum adaptations and teaching practices can transform mathematics from an exclusive discipline into a truly universal and accessible experience for all learners.

> Similar to medical doctors, teachers…..prescribe a healthy mathematics learning regimen of culturally relevant, high cognitive-demand tasks; pose increasingly laser-focused questions to assess students' current conceptions, and base their instructional decisions on individual and collective evidence of students' understanding. (Kebreab et al., 2021, p. 949)

In the following sections, we examine authentic engagement opportunities that support students' mathematical identity development while celebrating and honoring the diversity in this discipline. This journey will cover three themes that rest at the center of this article: (a) identity and inclusion in mathematics classrooms, (b) rethinking teacher preparation and professional development, and (c) centering voices often left out: highlighting the student experience.

## Making Math Matter

Mathematics instruction requires teachers to bring more than a deep understanding of the content to their toolkit. According to Parker-Holliman and Marcel-Herbert (2024), effective mathematics teaching requires a thoughtful, inclusive, and engaging approach with a relational connection to students' lives and cultures. Teachers "make real connections with their students, engaging them as fellow creative human beings who can do math and still have fun" (Henriksen & Mehta, 2016, p. 84). These connections led to meaningful, welcoming mathematics that reinforces the idea of inclusion. It helps students see that everyone can be a math person through engaging in interesting, real-world tasks (Parker-Holliman & Marcel-Herbert, 2024). Educators who teach

with a culturally relevant context provide an open door to connect to students' lived experiences and tie in curricula that are linked to things they care about. "It behooves us as teachers to know our students well enough to make and adjust both in-the-moment and long-term instructional decisions based on the most up-to-date knowledge of students' current needs" (Kebread et al., 2021, p. 949). As a result, we take knowledge out of a vacuum and into more relevant experiences, allowing for a more critical and authentic learning experience (Henriksen & Mehta, 2016).

## Identity and Inclusion in Mathematics Classrooms

To recognize students' mathematical brilliance, we must begin by acknowledging who they are, what they bring (funds of knowledge), and what prior experiences have shaped their view of mathematics. No matter the age, students enter classrooms with funds of knowledge that serve as a starting point in their growth journey, allowing us to form strong relationships with them along the way. "Individuality itself is a trait that had to evolve – an individual is not an indivisible entity, but a result of evolutionary processes" (Radzvilavicius & Blackstone, 2018, p. 1620). Applied to students, this means that who they are—their identities, ways of thinking, and approaches to learning mathematics—are not fixed or isolated. Instead, they are shaped over time by layered social, cultural, familial, and educational influences. Students' mathematical identity is not innate or singular; it is an evolving product of interactions with their environment, including how they have been taught, the perception of their abilities, and the opportunities they have had to engage with mathematics meaningfully. Centering students' identities and lived experiences can shift the narrative from deficit-based assumptions to asset-based approaches that celebrate the brilliance present in our classrooms.

In addition to acknowledging the foundational mathematics skills they bring, students need to see themselves reflected in mathematics. Illuminating the achievements of a diverse range of mathematicians makes it easier for others to envision their future mathematical accomplishments (Parker-Holliman & Marcel-Herbert, 2024). Honoring the diverse representations in mathematics provides a sense of belonging for students by elevating the funds of knowledge they have acquired from their families, communities, and cultural backgrounds. These foundational moves aid us in focusing on students' strengths to establish a bridge to learning.

Researchers define mathematical identity as a socio-motivational construct that refers to the deeply ingrained beliefs about someone's ability to participate and perform effectively in contexts involving mathematics as a learner and user of mathematics (Barba, 2022; Bohrnstedt et al., 2020; Dingman et al., 2019; Martin, 2009). Mathematical identity is not developed in isolation—it is shaped through interactions with teachers, peers, curriculum, assessments, and societal messages about who is considered good at math.

Students internalize these messages over time, which can either affirm or undermine their confidence and sense of belonging in mathematical spaces. Mathematical identity is dynamic and culturally situated (Dingman et al., 2019); it evolves through positive and negative learning experiences and is closely tied to students' racial, linguistic, gendered, and socioeconomic identities. Therefore, recognizing and nurturing positive mathematical identities requires intentional, equity-centered teaching that validates students' ways of thinking, leverages their funds of knowledge, and positions them as competent mathematicians. To build on identity-affirming instruction, we next explore the vital role of students' home-grown expertise, which is commonly known as funds of knowledge.

**Funds of Knowledge**

The concept of funds of knowledge, as introduced by Moll et al. (1992), refers to the accumulated knowledge and skills that students bring to their school experience from their homes and communities. Teachers who view students through this lens see them not as empty vessels, but as resources with meaningful knowledge that they can connect to the academic content. In mathematics classrooms, tapping into these funds of knowledge has proven to be a powerful way to promote conceptual understanding and inclusion (Wachira & Mburu, 2019; Williams et al., 2020). When students see their experiences reflected in the problems they solve (Matthews et al., 2022), when their ways of thinking are validated, and when instruction builds from what they already know, they are more likely to engage deeply and see themselves as capable mathematicians. Teachers must acknowledge, affirm, and elevate the rich, diverse, and valuable skills students have acquired from their families, communities, and cultural backgrounds to enhance and improve teaching and learning (Parker-Holliman & Marcel-Herbert, 2024).

**Grandmas' Hands**

Students enter school with an array of informal mathematical experiences that often go unrecognized by their teachers. For example, in homes where grandparents or elders are rearing students, they commonly engage in kitchen tasks that aid the family. These tasks include measuring ingredients, adjusting recipes when more family members visit, or even dividing portions of pans because grandma wants to ensure their household has leftovers, because face it, she is not cooking the following day. These seemingly informal experiences in students' homes expose them to concepts like measurement, fractions, and proportional reasoning.

**Tiles of Engagement**

Another example is children whose family members work in construction. These students often engage in hands-on learning as they observe and even assist with tasks such as measuring wood for a door frame or laying

tile in rows and columns (like the footlong tile in their classrooms). Such experiences naturally build spatial reasoning, measurement skills, and an intuitive understanding of geometry.

One former student stands out in particular. She shared that the tile on our classroom floor reminded her of the linoleum she had helped her uncle "put down" in his kitchen. She explained, "His foot fit inside the tile, but mine only fit halfway." That comment shifted the momentum of our lesson for the better. Her real-world connection sparked curiosity and clarity for the entire class, and her insight became a springboard for a deeper, more meaningful understanding of area and measurement. The discourse continued for days because of the real-world connection, sparking engagement among other students. What might have once seemed like an off-topic remark was a moment of brilliance, rooted in one student's lived experience and construction-based funds of knowledge.

### Gaming for Gratification

One last example is gaming. It is not just a pastime—it is a more complex, interactive tech-savvy environment where many students naturally engage in high-level thinking. Rather than dismiss gaming as a distraction, educators can view it as a great source of informal learning, especially in mathematics. Strategy-based and online games like Roblox allow students to develop and apply skills such as pattern recognition, logical reasoning, spatial awareness, and probability. On platforms like Roblox, students design, build, and code their own games or virtual spaces, which requires an understanding of geometry, sequencing, and measurement. They also engage in economic decision-making by managing their Robux (virtual currency, which they often ask the adults in their lives to purchase), comparing item prices, budgeting for upgrades, and making choices that involve trade-offs—all of which relate to unit rates, number sense, and financial literacy. When teachers recognize the value of these experiences and intentionally link them to more formal learning, they help validate students as doers and users of mathematics.

Recognizing and leveraging students' funds of knowledge requires that teachers see them as valuable assets to the learning environment. Unfortunately, many teacher preparation programs and professional development opportunities fail to equip educators with the tools to support inclusive and identity-affirming instruction. To create classrooms where all learners are seen, heard, and valued, we must start by rethinking how we prepare and support teachers for this work.

## Rethinking Teacher Preparation and Professional Development

In the introduction, we mentioned the survey results from ten of our friends; half were educators, and the others were not. We reflect on these results as an opportunity to expand our educator practice centered on inclusion in education. As we think about growing teachers and preparing them for the needs

of their multi-dimensional learners, we must think strategically about what that looks like from a practical and pragmatic stance. In this section, we want to take inclusion from the often secluded space of special education to an umbrella of access for all learners in mathematics, that is engaging and affirming of their identities.

Duchaine et al. (2021) share how educators can feel unprepared for inclusion, speaking specifically about the practice of teaching students with learning disabilities and related special needs. "Research indicates many pre-service teachers have limited, if any, coursework to equip them with the necessary skills for inclusive classrooms" (Duchaine et al., 2021, p.2). The same can be said for any classroom where educators are not fully supported or prepared to teach the content effectively; it limits the opportunity to build on the strengths and potential that all students bring. Having a disability does not disqualify a student from learning grade-level content. It simply means they may learn the content differently. We believe this statement connects to all mathematics students.

Research and practice support differentiated instruction to meet the needs of students receiving special education services. Differentiation is a flexible approach that allows students with disabilities to thrive in general education settings (Broderick et al., 2015). Differentiation is a practice that makes space for optimal learning of all students and their individual needs. Furthermore, beyond how students learn, where they learn also matters. Their learning environment plays a key role in shaping their academic and social experiences, reinforcing the importance of inclusive classrooms.

Hamre (2004) noted that university-based general education teacher preparation programs are expected to equip future teachers with the skills to plan instruction that meets the needs of a diverse range of learners. While the expectation remains today, the reality falls short. Many teacher preparation programs still do not provide enough practical training or coursework focused on inclusive, differentiated instruction, especially in content areas like mathematics. As a result, teachers tend to enter the classroom with limited tools for supporting diverse learners, including students with disabilities, multilingual learners, and those who have experienced interrupted or inequitable schooling. The gap in preparation impacts student outcomes, especially in mathematics, where conceptual understanding builds over time (Henriksen & Mehta, 2023; Hussein, 2022) and requires responsive, student-centered teaching (Alsina et al., 2025). To create classrooms where all students can access rigorous mathematics content, teachers must be prepared in pedagogy and understanding identity, accessibility, and the importance of cultivating a sense of belonging for all learners.

## Centering Voices Often Left Out - The Student Experience

In this section, we want to emphasize the concentrated efforts that should be enacted to provide access and equity to guarantee the inclusion of marginalized students. Over the years, marginalized students have taken on an array of definitions, so we must identify which one we embrace in this article. Marginalized students are unique; one definition does not provide a narrative that identifies each situation in their daily lives. Students of marginalization often live in poverty, are people of color, experience gender bias, come from a family with limited English proficiency, experience a learning or developmental disability, or are immigrants (Larson, 2010). Due to the impact of their marginalized status, many of our most promising students have underperformed academically. The good news is that as educators, we can reshape the narrative about who can excel in and enjoy mathematics (Parker-Holliman & Marcel-Herbert, 2024). Educators as a collective are super powerful in shaping their students' mathematical identities by communicating what mathematics is, what learning entails, and teachers can communicate to students that they are doers of mathematics (Barba, 2022; Martin, 2009; Parker-Holliman & Marcel-Herbert, 2024).

The mathematics teacher's role is essential in the development of student identities. Kebreab et al. (2021) remind educators that as we step into this work, we have "to address our own and our students' implicit and explicit beliefs about who is and can be a mathematician" (p. 953). Gutiérrez (2016) reminds us that people do not need mathematics; mathematics needs people, and that all mathematics teachers are identity workers. Acknowledging students' brilliance, recognizing what they bring to the table, and centering on their strengths are simple but practical strategies teachers can incorporate into their everyday routines to encourage and positively impact students' mathematical confidence and identity (Parker-Holliman & Marcel-Herbert, 2024).

### Mathematical Identity Mirror of Reflection

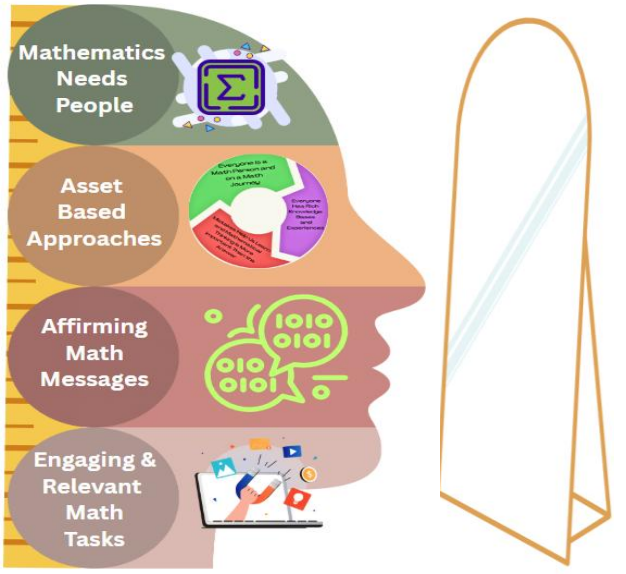
We propose that teachers implement four key components. We identified these integral attributes (Figure 1) essential to supporting students, which include (a) fostering a "Mathematics needs people" community; (b) implementing asset-based approaches (Rhodes, 2023); (c) encouraging students with positive, affirming messages; and (d) engaging students in relevant mathematics tasks.

### Mathematics Needs People

The first element includes every human being in a collective effort to change the narrative of who are doers of mathematics with urgency to embrace "everyone is a math person." Students must see themselves reflected in the field of mathematics. Because mathematics teachers play a significant part in children's mathematics identity building, they should regularly engage in

positive, affirming practices and messaging that work to build up confident students and foster warm and welcoming associations with mathematics (Barba, 2022; Parker-Holliman & Maina, 2023). Sharing the diversity in mathematics and its history allows students to imagine themselves contributing to the discipline.

**Figure 1**
*Mathematical Identity Mirror*



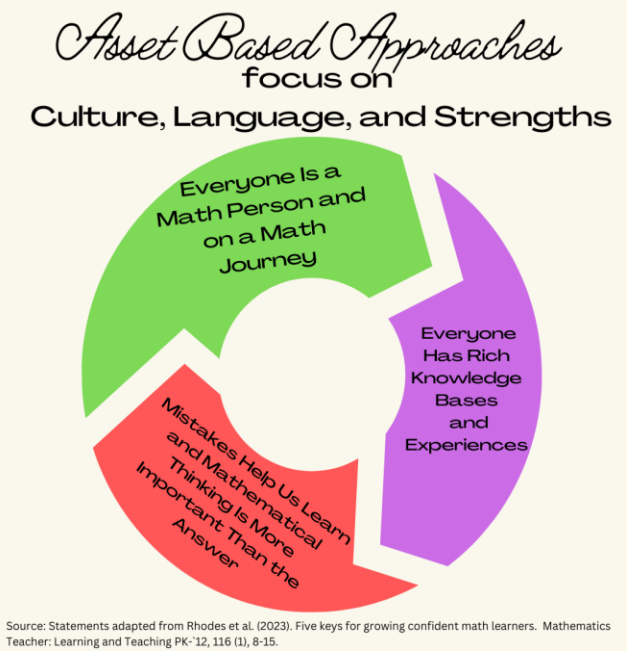

**Asset-Based Approaches**

Emphasizing the many contributions different people have made to mathematics begins the unpacking process of embracing asset-based approaches toward learning.

The asset model fosters a sense of belonging and prioritizes inclusion while focusing on students' language, culture, and strengths (Rhodes et al., 2023). There are three key ideas (Figure 2) that teachers can use to bring together the five keys for supporting confident mathematics students.

Teachers are encouraged to promote the qualities that help students see themselves as math people. For example, Rhodes et al. (2023) mention characteristics such as those who persist through challenges and others who find new ways to think about, solve, or explain mathematics problems. "These specific actions and ways of thinking must be praised rather than one's intelligence. When students hear their teacher praise another student for being smart, they may begin to question their own abilities, focusing exclusively on determining whether or not they are smart" (p. 10). Everyone is on a math journey, and it behooves us to celebrate the growth of all students along the way.

**Figure 2**
*The Five Keys of Asset-Based Approaches Summarized*




**Positive Affirming Messages**

The messages we send to students are opportunities to speak life into them. It is a proverbial stance that "life and death are in the power of the tongue" (King James Version Bible, 2001, Proverbs 18:21), and we stand in this truth. This proverb simply suggests that the words we use with students can build students up or, potentially, damage students and tear them down, impacting their mathematical identity in significant ways. Students should hear affirmations such as those in Figure 3.

"Teachers' interactions and language use are integral in shaping students' beliefs and identities about themselves and mathematics" (Rhodes et al., 2024, p. 15). All students bring funds of knowledge that teachers and support staff can find valuable. Our task is to uncover and showcase the greatness in our students so we can build their confidence to tackle areas of opportunity they will encounter in mathematics.

**Relevant Mathematics Tasks**

When teachers engage students in relevant mathematics tasks, they provide opportunities that connect to students' lives, spark students' interest, and have significance in the social phenomenon that impacts their current situations, including those that are meaningful for their communities. Although these three items are not all encompassing, they foster mathematical interest, relevance, and success for students.

For a more scholarly description of relevant mathematical tasks, we turn to the work of Gloria Ladson-Billings (1995) and Matthews et. al (2022) who share similar narratives about culturally relevant teaching and learning in education.

**Figure 3**

*Positive Affirming Messages that Support Math Identity Building*


**Culturally Relevant Pedagogy (CRP)**

Ladson-Billings is the originator of CRP and coined the term. CRP includes three distinct domains as Ladson-Billings dared to investigate what was right with marginalized, specifically African American, students and what happens in the classrooms of teachers who experience pedagogical success with them (2014). She identified the following domains: academic success, cultural competence, and sociopolitical consciousness. In an article reflecting on the significance of her work, Ladson-Billings (2014) shares:

> By focusing on student learning and academic achievement versus classroom and behavior management, cultural competence versus cultural assimilation or eradication, and sociopolitical consciousness rather than school-based tasks that have no beyond-school application, I was able to see students take both responsibility for and deep interest in their education. This is the secret behind culturally relevant pedagogy: the ability to link principles of learning with deep understanding of (and appreciation for) culture. (p. 76-77)

Since the creation of CRP, several ideas of thought have been introduced and implemented in schools to support all learners. One of these is the work by Matthews et al. (2022), which specifically embeds the CRP domains into mathematics teaching and learning.

**Culturally Relevant Mathematics Tasks**

Tasks designed to assist learners in understanding mathematics deeply often make connections within and among the communities, and empower them to reimagine the world around them, are culturally relevant mathematics tasks. Students would benefit from mathematical tasks designed to reinforce the demand for high-quality, grade-level appropriate applications that connect to their world (Matthews et al., 2022). Students engaged in relevant tasks often experience greater interest and a heightened motivation for learning (Parker-Holliman & Spires, 2024). Students today will gain much from engaging in research-based teaching practices, a pedagogy that helps them to develop deep conceptual understanding, procedural knowledge, fluency, and application of mathematical content. When we think of engagement, we refer to activities and tasks that students are interested in doing, that spark their curiosity or encourage them to solve an issue to better their family and communities. "One of the first realizations that education is a powerful tool emanates from students' interaction with teachers who provide illustrative evidence of success as educational professionals" (Parker-Holliman & Spires, 2022, p. 694). The relationships established through students' learning and schooling set the foundation for their success. We turn to the data that examines the changing demographics in our country, which is apparent in our current classrooms.

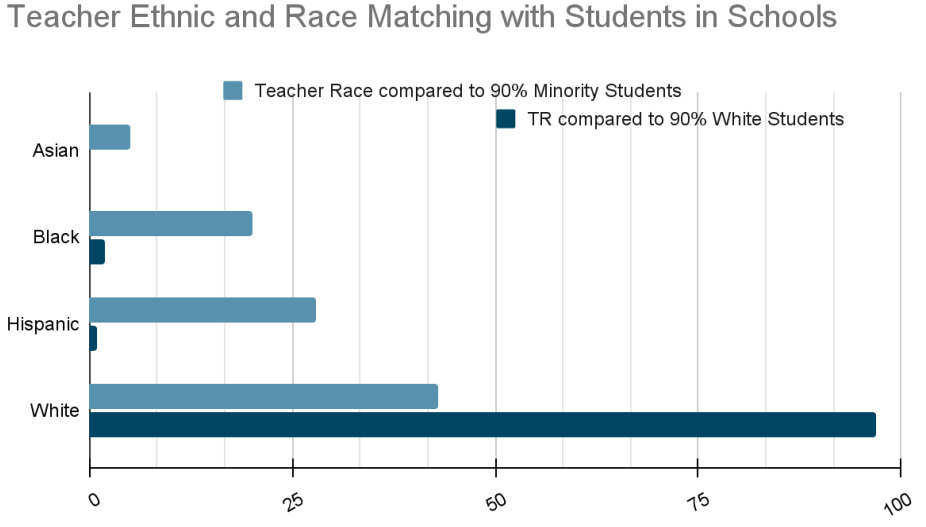
According to data released by the Pew Research Center, Schaeffer (2021) reported that the majority of public-school teachers in the United States—roughly 79%—are non-Hispanic White, with a large proportion identifying as female. This data means teachers are often not as racially or ethnically diverse as their students. In schools with higher populations of students of color, the teaching staff tends to be more diverse (Figure 4), with increased numbers of Hispanic, Black, and Asian American educators. For example, in schools where 90% or more of students are from minority groups, 28% of teachers were Hispanic, 20% were Black, 5% were Asian, and 43% were White (Schaeffer, 2021). On the other hand, in schools with a student population that is 90% or more White, nearly all the teachers (97%) were also White. This trend (Figure 4) illuminates how often students are learning in schools with students who share the same racial or ethnic background and illuminates how white students are often taught by teachers who share their racial background. These statistics may suggest that efforts should focus on recruiting more minority teachers, but Emdin (2016) argues for a concerted effort to improve the teaching of current white teachers, those who aspire to teach, and all engaged in" white folks" pedagogy of all ethnic and racial backgrounds.

In a recent study by Parker-Holliman & Spires (2022), three ideas were considered as we develop promising opportunities with the ever-changing student and steady teacher demographics in American classrooms. They found that successful educators teach with a critical lens of care focused on developing welcoming and trusting relationships with their students. Since the student

demographics are rapidly diversifying, success is found in a concentrated effort to understand students and their cultures. Although developing caring and legitimate relationships can be a challenge for some teachers who have different backgrounds and cultures than the students they teach, success has been achieved by educators with increased intentionality approaches (Parker-Holliman & Spires, 2022).

**Figure 4**

*Graphical Representation of Teacher-to-Student Racial Comparison* (Schaeffer, 2021)




## Conclusion

America's educators can lean deeply into our own and our students' power to build their confidence in mathematics and their sense of belonging, positively impacting their mathematics identity (Parker-Holliman & Marcel-Herbert, 2024). Ending this article allows us to embrace the 1990s classic of Snap's popular song, "The Power" (SNAP!, 2011). The song brings a feeling of strength and confidence, with some interpretations suggesting a message of hope and celebrating the ability to make a difference, whether through personal actions or seeking help from higher powers. It is our hope that teachers feel the same powerful message. The chorus is the anthem that we want all teachers, educational leaders, and preservice teachers (college personnel) to embrace. The chorus lyrics repeatedly suggest, "I've got the power" (Snap, 1990).

Mathematics classrooms should be places where every student feels a sense of inclusion; they should feel seen, heard, and valued for what they know and who they innately are. Throughout this article, we have explored the role that identity, culture, and inclusion play in shaping students' experiences with

mathematics. We have highlighted how students enter classrooms with rich, untapped funds of knowledge that are often overlooked or discarded due to the nature of checking boxes off to-do lists that often thwart the fun of teaching and learning. When teachers are equipped to recognize and build on student assets, they foster a sense of belonging and help students form positive mathematics identities. We have also discussed teacher preparation and professional development. Inclusive, identity-affirming instruction cannot happen without educators prepared to teach responsively and with cultural humility. This work requires more than content expertise; it includes courage, curiosity, and a belief in the brilliance of every learner. Educators must question who we center in our lessons, whose knowledge we validate, and how we create mathematical spaces where all students feel capable and connected. Inclusion should not be viewed as a strategy; it is a stance we should take to teach all students. Moreover, when we take that stance, we close the gap between who mathematics currently serves and who it should serve: everyone, because everyone is a math person (Parker-Holliman & Marcel-Herbert, 2024).

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