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Strength-based strategies and assets that Black and Latina/o middle and high school students use to navigate contextual barriers of math engagement

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Background: Racial disparities in math remain a critical issue in the United States. For example, the U.S. educational system often fails to recognize or uplift the funds of knowledge and other cultural assets that Black and Latina/o students possess, which has implications for their engagement in math. The goal of this study is to understand, from the perspectives of Black and Latina/o students, what are the salient barriers for math engagement. Importantly, aligned with our strength orientation, we also aim to understand what assets-based strategies Black and Latina/o students use to navigate the barriers.

Results: Black and Latina/o students ($n = 107$) reported barriers to math engagement that span across the micro- (e.g., classroom management and structure), exo- (e.g., distractions from personal technology use), macro- (e.g., math stereotypes and misconceptions), and chrono-system (effects of COVID). To navigate those barriers, Black and Latina/o students identified various assets, such as study strategies, interactive instruction, good use of technology, peer support and collaborative learning, teacher support, positive teacher-student relationships, and family support and capital.

Conclusion: In presenting both the barriers Black and Latina/o students face for their math engagement, as well as the strength-based strategies they utilize to navigate such barriers, we present a holistic view of math engagement that centers the role of culture and contexts. Overall, our findings contribute to a more humanizing way to understand the educational inequities that Black and Latina/o students navigate in STEM.

KEYWORDS

math engagement, barriers, strength and assets, community cultural wealth, cultural microsystem model

Introduction

Racial disparities in math remain a critical issue in the United States. Only 9% of Black students and 14% of Hispanic students in 8th grade meet NAEP (National Assessment of Educational Progress) proficiency, a stark contrast to 25% of their White peers (U.S. Department of Education, 2022). Such racial disparities in math performance have significant implications for both individual mobility and broader societal inequality, given that math is a critical gatekeeper for access and success in other fast-growing STEM fields (National Council of Supervisors of Mathematics and National Council of Teachers of Mathematics, 2018; Stinson, 2004; Watt et al., 2017). The racial disparities also have implications for students' day to day, including how they show up and engage in their math classes. Importantly, the racial disparities have structural roots—they are shaped by contextual factors that disproportionately influence Black, Latina/o,¹ and other marginalized students' experiences with math education. Despite these challenges, Black and Latina/o students actively draw on various strengths and cultural resources to persist in math. More research is needed to understand how these students navigate barriers using strength-based strategies. Using qualitative methods, this study explores the perspectives of Black and Latina/o students to identify the key challenges they face in math and the strategies they use to stay engaged.

Structural roots and systemic barriers

Much of the racial disparities in math can be attributed to the structural and systemic barriers that disproportionately affect Black and Latina/o students. One key factor is the inequitable access to high-quality math learning opportunities, which persists throughout the K-12 pipeline in the U.S. (Davis et al., 2019). In math classrooms, students experience both covert and overt biases, including stereotypes, microaggressions, and being overlooked for advanced classes (Copur-Gencturk et al., 2020; Grossman and Porche, 2013). Such biases directly and indirectly shape students' math engagement (Wang et al., 2024). For example, recent studies of middle and high school students from diverse racial and ethnic backgrounds found that perceptions of math/STEM teacher discrimination were associated with lower math/STEM engagement (Del Toro et al., 2024; Mulvey et al., 2022). As another example, some math curricula may lack cultural responsiveness or fail to reflect diverse perspectives (Collins, 2018; Mathews et al., 2022), which could hinder Black, Latina/o, and other marginalized students' sense of belonging in the classroom, their motivation, and their ability to fully engage in math and reach their academic potential.

Black and Latina/o youths' assets and resilience: a community cultural wealth perspective

Despite the structural and systemic barriers that they disproportionately face, Black and Latina/o youths continue to demonstrate resilience in math. The community cultural wealth model (Yosso, 2005), highlights that, although often unrecognized by educational systems, Black, Latina/o, and other students from marginalized backgrounds bring tremendous assets into the classroom. These include educational aspirations and resilience despite obstacles (aspirational capital), knowledge and skills for navigating complex and often racialized systems (navigational capital), motivation to fight against unfair systems (resistant capital), diverse communication skills (linguistic capital), access to community networks and support (social capital), and cultural and experiential knowledge passed through families (familial capital) (González et al., 2013; Nasir et al., 2008).

Studies from a cultural-wealth perspective suggest that Black, Latina/o, and other students from marginalized backgrounds bring these strengths into math learning spaces. For example, a recent systematic review found positive relations between parents' STEM-specific support and Black and Latina/o middle and high school students' STEM motivational beliefs (Starr et al., 2022). McGee and Spencer's (2015) study with high-achieving Black students in STEM showed that parents played a major role in fostering STEM success through instilling persistence, encouraging their self-efficacy, and serving as role models. Relatedly, studies have found that Black and Latina/o parents foster their children's math and STEM learning by emphasizing the value of education as a pathway for better opportunities (Martin, 2006; Soto-Lara and Simpkins, 2022). These studies illustrate the rich familial capital and broader community cultural wealth that Black, Latina/o, and other marginalized students bring to math learning.

Over time, Black, Latina/o, and other students from marginalized backgrounds may internalize aspects of their community cultural wealth as personal strengths. For example, STEM can elicit assets such as critical consciousness that are particularly critical for the thriving of students from marginalized backgrounds (Mathews et al., 2025; Upadhyay et al., 2021). Relatedly, the barriers that these students navigate in math may strengthen their motivation to disprove stereotypes (Fries-Britt and Onuma, 2020; Wilson and Matthews, 2024), though not to downplay the substantial emotional tolls that such a process of resiliency takes. These internal assets contribute to the development of strong and healthy math/STEM identities (Berry et al., 2011; Collins and Jones Roberson, 2020). Despite the valuable assets that Black, Latina/o, and other marginalized students bring to math and STEM, the community cultural wealth framework remains underutilized in STEM research. A recent systematic review suggested that the community cultural wealth framework is still not widely used in STEM compared to studies that examine marginalized students from a deficit-based perspective (Denton et al., 2020). This gap underscores the need for more research that centers the strengths and lived experiences of marginalized students in STEM.

Theoretical framework: the cultural microsystem model

With the goal to understand the various and interrelated barriers and assets that Black and Latina/o students face and utilize

¹ We use "Latina/o" as an umbrella term for people who identify as Hispanic, Latina/o/x/é, or Spanish origin. We acknowledge that the term "Latina/o" might not resonate with every individual categorized in this group, including those who hold a non-binary gender identity.

for their math engagement, we use the cultural microsystem model developed by Vélez-Agosto et al. (2017). The cultural microsystem model adapted Bronfenbrenner's bioecological theory (Bronfenbrenner and Morris, 2006) by centering cultural processes as fundamental to development. Specifically, the cultural microsystem model drew upon Vygotsky's Sociocultural Theory, Weisner's Ecocultural Theory, and Rogoff's transformation of participation perspective to argue that culture is inseparable from human development and its layered contextual influences. As such, the cultural microsystem model recognizes that "mathematics, like all other forms of knowledge, is situated within a cultural context" (p. 262, Leonard et al., 2010).

We use the cultural microsystem model to guide this study for two main reasons. First, its bioecological foundation provides a framework for organizing math engagement barriers and assets across different ecological levels. Examining these factors at multiple levels allows us to understand how immediate environments, connections between those environments, and broader societal influences collectively shape math engagement. At the most immediate level, the microsystem includes students' direct interactions within classrooms, families, and peer relationships. Beyond this, the exosystem consists of broader school structures and policies, such as access to resources, tracking, and school climate, which influence students indirectly. The macrosystem encompasses the larger societal and systemic forces that shape math engagement, including racialized perceptions of ability, structural inequities, and dominant cultural narratives about who is "good" at math. Lastly, the chronosystem captures the influences of time or historical context on students.

The other main rationale for using the cultural microsystem model to guide this study is that the model centers the role of cultural processes, which aligns with our focus to examine the inequities that Black and Latina/o students navigate in math learning. Importantly, centering the role of cultural processes also makes room to examine the assets and strengths that marginalized students draw upon to navigate the barriers, which ties back to the community cultural wealth perspective (Yosso, 2005) that we reviewed in the previous section.

Current study

This study examines two central research questions: (1) What are the barriers to math engagement from the perspective of Black and Latina/o students? (2) What strengths-based strategies and assets are Black and Latina/o students utilizing to navigate these barriers?

We intentionally focus on the developmental period of adolescence for two main reasons. Firstly, students' math motivation and engagement typically decline during this developmental period (Fredricks and Eccles, 2002; Denner et al., 2019; Gottfried et al., 2007; Martin et al., 2015; Musu-Gillette et al., 2015); making it critical to understand the factors that hinder and support students' math engagement during this developmental period. Secondly, a significant milestone of adolescence is the negotiation of identities, including one's math identity (Berry et al., 2011; Collins and Jones Roberson, 2020). By examining both the barriers and the strategies that adolescents use to navigate them, this study offers important insights into how to better support Black and Latina/o students' engagement and success in math.

Method

Study context

This study is part of a larger, three-year project that aims to develop a measure of Black and Latina/o students' math engagement. The project took place in a school district that is located in the Minneapolis-St. Paul (MN) metropolitan area in Minnesota, U.S. All three middle schools (one is predominantly attended by White students, one is racially/ethnically diverse, and one is predominantly attended by student of color; see the notes section of Table 1 for more detail) and two high schools (one is predominantly attended by student of color, the other is predominantly attended by White students) in the district participated in this project. In this school district, most students take math all throughout middle school, but not necessarily all throughout high school since the state only requires three credits of math for graduation.

It is important to disclose these contextual information for this study as we attend to issues of educational/math inequities and systemic barriers that students from marginalized backgrounds face. For example, according to recent (2019) data from the districts' North Star system results (i.e., state-wide accountability indicators), Black students had a math achievement rate of 27 percent and Latina/o students had a rate of 31 percent, a stark contrast to the 54 percent state average (Minnesota Department of Education, 2019).

Approach to data collection and participant information

The data for this study came from focus groups conducted with 50 Black and Latina/o students conducted in Spring 2023, and with 57 Black and Latina/o students conducted in Spring 2024. See Table 1 for more detailed participant demographics. A qualitative approach was used to capture how Black and Latina/o students conceptualize math engagement, allowing for a deeper understanding of their experiences than surveys or standardized assessments might reveal. Focus groups were selected as the primary method because they provided a structured yet flexible setting where students could share their perspectives, reflect on their engagement in math, and build on one another's insights (Creswell, 2012).

The focus group protocols were designed to explore how Black and Latina/o students experience engagement in math, with questions aimed at understanding both barriers and strength-based strategies (see Appendix 1 for full protocols). The Spring 2023 focus groups focused on understanding students' experiences with math engagement and the factors that influence it. The discussions included questions about what makes students feel engaged or disengaged, the role of their learning environment, and the challenges they encounter in math classrooms. Students were also asked about barriers to engagement, including instructional practices, classroom interactions, and broader perceptions of who is seen as a "math person." Additionally, the protocol included questions about strength-based strategies, prompting students to describe the resources and approaches they use to stay engaged, such as seeking support from teachers, peers, and family or using personal strategies to persist in math.

TABLE 1 Participant background information.

Pseudonym	School (group)	Grade	Gender	Race/Ethnicity	Do you like math?	Data collection year
Students						
Barney	AC (1)	6th	Female	Mixed/Black	No	2023
Sam	AC (1)	7th	Girl	African American	No	2023
Camilla	AC (1)	6th	Female	African American	No	2023
Cruz	AC (1)	6th	Male	Black	I do not have an opinion	2023
Bobby	AC (1)	6th	Male	African American	Yes	2023
Abe	AC (1)	7th	Boy	Black/African American	Yes	2023
Sophia	AC (1)	6th	Female	African American	Yes	2023
Elpayaso	AC (2)	6th	Male	Latino	Yes	2023
Habiba	AC (2)	6th	Male	Hispanic	Yes	2023
Edgar	AC (2)	6th	Male	Latino	No	2023
Bee	AC (2)	7th	Female	African American	Yes	2023
Sarah	AC (2)	7th	Female	Latino	No	2023
KJ	AC (2)	6th	Girl	Black/Asian	No	2023
AK	KJ (1)	8th	Male	African American	Yes	2023
Ben	KJ (1)	8th	Male	Latino	Yes	2023
Caleb	KJ (1)	8th	Male	Hispanic	Yes	2023
Jacob	KJ (1)	8th	Male	Black	No	2023
Yussuf	KJ (1)	8th	Male	Black	No	2023
Abu	KJ (1)	8th	Male	Black	Yes	2023
Shumar	KJ (2)	8th	Male	African American	No	2023
Emily	KJ (2)	8th	Female	Somali	middle	2023
Helena	KJ (2)	8th	Female	African American	maybe	2023
Valeria	KJ (2)	8th	Female	Hispanic/Latino	idk	2023
Jasmine	KJ (2)	8th	Female	African American	yes	2023
Aisha	KJ (2)	8th	Girl/female	Somali	no	2023
Keke	CM (1)	7th	Girl	Black	Yes	2023
Riah	CM (1)	6th	Female	Black	Yes	2023
Alex	CM (1)	7th	Male	Mexican American	Yes	2023
Jordan	CM (1)	8th	Male	African American	Yes	2023
Amari	CM (2)	6th	Female	Black	Yes	2023
Smith	CM (2)	8th	Female	Black	Yes	2023
Brian	CM (2)	8th	Male	Hispanic	Yes	2023
Hector	CM (2)	8th	Male	Hispanic	Yes	2023
Luis	CM (2)	8th	Male	Hispanic	Yes	2023
Emma	HRT (1)	10th	Female	African American	Yes	2023
Jhonny	HRT (1)	10th	Male	African American	Yes	2023
Alan	HRT (1)	10th	Male	Black/African American	Yes	2023
Alax	HRT (1)	10th	Male	Black/Hispanic	Yes	2023
London	HRT (1)	10th	Female	African American	Yes	2023
Amani	WLH (1)	9th	Male	Black/African American	Yes	2023
Aliyah	WLH (1)	9th	Female	Somali	Yes and no	2023
Jess	WLH (1)	11th	Female	Hispanic	Yes and no	2023

(Continued)

TABLE 1 (Continued)

Pseudonym	School (group)	Grade	Gender	Race/Ethnicity	Do you like math?	Data collection year
Jacxs	WLH (1)	11th	Male	African American	Yes	2023
Blue	WLH (1)	9th	Female	Hispanic	Yes	2023
Jamal	WLH (1)	9th	Male	African American	Yes	2023
Salmi	WLH (2)	10th	Female	African American	Yes	2023
Carmen	WLH (2)	9th	Female	Mexican	Yes	2023
Isabel	WLH (2)	9th	Female	Mexican/Hispanic	Yes	2023
Bob	WLH (2)	9th	Male	Hispanic/Latino	Sometimes, depends on the unit	2023
Tomas	WLH (2)	12th	Male	Hispanic	Yes	2023
Eileen	AC (1)	6th	Female	Mexican	Kind of	2024
Alex	AC (1)	7th	Female	Mexican	Yes	2024
Leah	AC (1)	7th	Female	Black & Asian	Yes	2024
James	AC (1)	6th	Male	Black	Yes	2024
Gustavo	AC (2)	6th	Boy	Hispanic	Yes	2024
Kylie	AC (2)	8th	Female	African American	Yes	2024
Vanessa	AC (2)	7th	Female	Mexican	Yes	2024
Mason	AC (2)	6th	Boy	Black	Yes	2024
Willow	AC (2)	7th	Any	German/Spanish/Swedish/Native	Yes	2024
Stella	KJ (1)	7th	Female	Black/African American	Yes	2024
Hermione	KJ (1)	6th	Female	Hispanic	Yes	2024
Nora	KJ (1)	8th	Girl	Somali	Yes	2024
Sam	KJ (1)	6th	Male	Latino/Hispanic	Yes	2024
Thomas	KJ (1)	6th	Male	African American	Yes	2024
Bella	KJ (1)	6th	Female	Hispanic Ecuadorian	Yes	2024
Rosa	KJ (1)	7th	Female	Somali/Black	Yes	2024
Jay	KJ (2)	8th	Male	Black Somali	No	2024
Charles	KJ (2)	6th	Male	African American	No	2024
Anna	KJ (2)	8th	Female	Mexican	No	2024
Johnathan	KJ (2)	7th	Male	Mexican, Salvadoran, Puerto Rican	Yes	2024
Toby	CM (1)	8th	Girl	Hispanic	Yes	2024
Mercy	CM (1)	8th	Female	Hispanic	Yes	2024
Jamal	CM (1)	8th	Male	Black	Yes	2024
Miguel	CM (1)	8th	Male	Hispanic	Yes	2024
Tyrone	CM (1)	8th	Female	African American/White	Yes	2024
Junior	CM (2)	7th	Male	Black/African American	Yes	2024
Noah	CM (2)	7th	Male	Mexican	Yes	2024
King	CM (2)	7th	Male	Black	Yes	2024
Kimberly	CM (2)	7th	Female	Mexican	Yes	2024
Lebron	CM (2)	7th	Male	Hispanic	Yes	2024
Tyreese	HRT (1)	10th	Male	African American (Black)	Yes	2024
Eric	HRT (1)	9th	Male	Hispanic	No	2024
Ken	HRT (1)	9th	Male	Black	Yes	2024
Trey	HRT (1)	10th	Male	African American	Yes	2024
Neymar	HRT (1)	9th	Male	Hispanic	Yes	2024

(Continued)

TABLE 1 (Continued)

Pseudonym	School (group)	Grade	Gender	Race/Ethnicity	Do you like math?	Data collection year
Joel	HRT (1)	9th	Male	Hispanic	Yes	2024
Daquan	HRT (1)	10th	Male	Black	Yes	2024
Evan/Josh	HRT (1)	10th	Male	Black	Yes	2024
Participant	HRT (1)	unknown	Male	Black presenting	unknown	2024
Yussuf	HRT (2)	9th	Male	Black/African American/Somali	Yes	2024
Naz	HRT (2)	9th	Male	African American	Yes	2024
Jake	HRT (2)	9th	Male	Black	Yes	2024
Greg	HRT (2)	10th	Male	Black	Yes	2024
Bryce	HRT (2)	9th	Male	Hispanic	Yes	2024
Rock	HRT (2)	9th	Girl	Black	Yes	2024
Shane	HRT (2)	9th	Male	Black	Yes and no	2024
Lilly	WLH (1)	11th	Female	Latino	Sometimes	2024
Plush	WLH (1)	11th	Male	Hispanic	Yes	2024
Michaela	WLH (1)	9th	Female	Black	No	2024
Joe	WLH (1)	10th	Male	Hispanic	Yes	2024
Joaquin	WLH (1)	11th	Male	Latino	No	2024
Sprite	WLH (2)	11th	Female	Black	Yes	2024
Yaretzi	WLH (2)	9th	Female	Mexican	Yes	2024
Jess	WLH (2)	11th	Girl	Hispanic	Yes	2024
Oscar	WLH (2)	10th	Male	Hispanic	Yes	2024
Lauren	WLH (2)	9th	Female	Black	Yes	2024
Summer	WLH (2)	9th	Female	African American	Yes	2024

For schools, AC = Alexa Canady Middle School (racially/ethnically diverse), KJ = Katherine Johnson Middle School (predominantly attended by White students), CM = César Milstein Middle School (predominantly attended by student of color), HRT = Helen Rodríguez Trias High School (predominantly attended by White students), WLH = Walter Lincoln Hawkins High School (predominantly attended by student of color). We used participant’s self-reported race/ethnicity and gender identity verbatim to honor their voice.

The Spring 2024 focus groups expanded on these discussions, incorporating questions to deepen understanding of how students experience support in math. Students were asked to recall specific moments when they felt supported, who provided that support, and how it influenced their engagement. The discussions also explored how students perceived others’ views of their math abilities and whether those perceptions affected their confidence and participation. These follow-up questions were intended to provide a more detailed understanding of the types of support that contribute to students’ engagement and persistence in math.

Each focus group consisted of 4 to 7 students, lasted approximately 90 min (Spring 2023) or 60 min (Spring 2024), and was conducted in person. The student participants were recruited by teacher co-researchers who are part of the larger project team. The teacher co-researchers were informed of the purpose and goal of the focus groups and were asked to recruit students who identify as Black and/or Latina/o. We intentionally asked the teacher co-researchers to recruit students from a range of engagement levels in math to capture a diverse perspective of student’s lived experiences, which helps strengthen the transferability and thus trustworthiness of our data. When participants signed in for their focus group, they filled out a paper slip that asked for their grade, gender, race/ethnicity, and their response to the question “do you like math?” (see Table 1). All study

procedures were approved by the Child Trends Institutional Review Board (IRB#: FWA00005835). Each student received a \$50 electronic gift card as compensation for their time and insights.

Plan of analysis

All focus group discussions were audio-recorded and transcribed verbatim using an online transcription service. We conducted a thematic analysis (Braun and Clarke, 2012), which involves identifying, analyzing, and interpreting patterns of meaning across qualitative data. Our analytic process was both theory-driven and flexible, guided by the cultural microsystem model (Vélez-Agosto et al., 2017), which helped us consider how students’ math engagement is shaped by factors at different levels—from classroom relationships and school environments to broader social and cultural dynamics.

To develop our initial codebook, the first author reviewed approximately half of the transcripts, creating preliminary codes informed by prior literature on math engagement and equity (Berry et al., 2011; Leonard et al., 2010; Denner et al., 2019). Our research team then collaboratively tested and refined this codebook by discussing examples and adjusting definitions based on additional student responses. For example, as students described personal

strategies—such as independently managing distractions or maintaining focus during challenging lessons—it became clear these did not fit neatly within existing ecological categories (micro, exo, macro). Thus, we added an intrapersonal category to more accurately reflect these individual-level approaches. As analysis progressed, we noticed that some strategies students described were closely connected to specific challenges, while others offered more general support that cut across multiple types of barriers. We approached the analysis with this flexibility in mind, remaining grounded in what students said while also considering how their strengths related to the barriers they described.

All coding was conducted in Dedoose. Each transcript was initially coded by a team member and then reviewed by another to check for accuracy and consistency. The research team met regularly to review the transcripts together, clarify discrepancies, and ensure shared understanding of how codes were applied. After the coding phase, the first and second author met to cluster related codes into themes and finalize their definitions. We also used memoing throughout the process to document emerging insights and reflect on how our interpretations evolved over time. Overall, the collaborative and iterative approach to coding helps strengthen the dependability and hence trustworthiness of our data analysis.

Positionality

This study was a team effort, and we are mindful of the various perspectives each of us brought to the team and how they might shape interpretation. Specifically, the study team, who are also the authors of this manuscript, consisted of five researchers (from four research organizations), as well as six students and five math teachers (from each of the five participating middle and high schools). With a team of this size, we drew on a wide range of personal, professional, and practice-based experiences related to equity and math education. We are also diverse in terms of our lived experiences with math. While all student co-researchers identified as Black and/or Latina/o, most of our teachers and researchers identified as White or Asian (American). Beyond these difference in our racialized experiences with math, the teachers and researchers in our team are also cognizant that our math upbringings differed from the students, partly due to generational differences. As part of the larger study, we met regularly and drew on each other's expertise to inform our understanding and interpretation of the focus group data. For example, while the researchers were responsible for most of the data analysis in terms of coding, we relied on the student and teacher co-researchers for member checking, which helped strengthen the credibility and thus trustworthiness of our findings.

Results

Barriers to math engagement for black and Latina/o students

To answer research question 1, which focused on identifying barriers to math engagement, this section describes the challenges Black and Latina/o students reported across multiple ecological levels, organized using the cultural microsystem model. Table 2 summarizes

the major themes, definitions and illustrative quotes related to these barriers.

Micro-level barriers

Six key barriers to math engagement for Black and Latina/o students emerged at the micro-level—that is, barriers rooted in students' everyday interactions within their immediate settings, such as classrooms, peer groups, and home life. These included: negative teacher-student relationships, classroom management and structure, limited teacher support, peers as a distraction, family obligations and “limited” support, and lack of basic resources.

Negative teacher-student relationships were the most commonly mentioned barriers. Students shared how hard it was to stay engaged when they felt that their math teachers were rude, impatient, or dismissive—especially when asking for help. For example, Emily explained,

“I feel like I do not want to ask my math teacher too much questions because like by the second question I ask, she like gets like irritated.”—Emily² (Somali, female student in 8th grade).

These experiences often left students feeling embarrassed or unwelcome, weakening their confidence and willingness to engage. Students also recalled moments where they felt singled out or unfairly treated, contributing to a sense of exclusion in the classroom:

“I have a teacher in trimester two this year and she was, like, favoriting, like, students. And when I asked a question, she'd look at me like I was dumb or something. [...] And then she would come and assist us, but after she explained one or two times, then she'd kind of be like, ‘Oh, why are you not getting this?’”—Salmi (African American, female student in 10th grade).

Classroom management and structure also came up as a related barrier. Students noted that it was hard to concentrate when classmates were being disruptive or loud during instruction or work time. Some described feeling frustrated when their teachers had to focus more on managing behavior than on teaching. As Salmi (African American, female student in 10th grade) put it, “class needs to be stopped sometimes for people to really focus.” In terms of classroom structure, students often spoke about lecture-style instruction (for example, when “[the teacher] talks more to the class than actually letting us do the work” [Jacob; Black, male student in 8th grade]) as disengaging. Some described these lessons as repetitive or disconnected from their own ways of learning. Others shared how the pace of instruction—either too fast or too slow—affected their ability to follow along:

Aisha (Somali, female student in 8th grade): When she moves like too fast and I'm actually trying to keep up. And then like I'm in the middle of writing down a problem when she goes to the next

2 All student and school names are pseudonyms to protect participant's confidentiality. Students decided on their own pseudonyms during the assent process. We used participant's self-reported race/ethnicity verbatim to honor their voice.

TABLE 2 Barriers to math engagement for Black and Latina/o students.

Theme	Definition	Illustrative quote
Micro-level barriers		
Negative teacher-student relationships	Ways that students find it hard to engage in math because of the experiences and perceptions of negative interactions with their math teachers.	"I have a teacher in trimester two this year and she was, like, favoriting, like, students. And when I asked a question, she'd look at me like I was dumb or something. [...] And then she would come and assist us, but after she explained one or two times, then she'd kind of be like, 'Oh, why are you not getting this?'"—Salmi
Classroom management and structure	Ways that math teachers manage or structure their classroom that have negative implications for students' engagement. subcodes include: disruptive/distracting classroom, lecture style instruction, and teacher going too fast or slow.	"My math teacher, like—there's no engaging. Like, she never asks you. Like, she just does the work on the board, and then you do it."—Emily
Limited teacher support	Ways that math teachers' lack of (proactive) support hinders students' math engagement. Subcodes include: teacher not proactively helping; waiting too long to get teacher help	"Camilla: When I go up to her and ask for her help, she says—Sophia: She says, 'Do it on your own.' Camilla: Exactly. She says, 'Do it on your own,' or, 'Figure it out.' I asked for help and she did not help. Sam: I'll ask for help, and she was like, 'You should have known this since last year.'"
Peers challenges	Peers "messaging around," not working together, or in other ways distract students from engaging in math.	"I'm, like, more focused when my friends are not around" -Abe
Family obligations and "limited" support	Ways that student's family obligations (e.g., chores, child care, work to supplement family income) and limited support from family members hinder their math engagement	"I feel like the type of math we are in, yeah, my parents aren't able to help me with it anymore." -Emma
Lack of basic resources	Ways that students find it hard to engage in math because they are hungry, tired, or because they do not have pencils to work with.	"This is more a personal problem for me. But, like, I did not have a pencil for, like, the past, like, month and a half. So I had to do it in pen. [...] But, for math, they always say pencil, because, like—well, if you make a mistake... And it, like, stressed me out so much because it's the only writing utensil I had. And I only had one pen, too. Like, if I lost that pen, I was screwed for the rest of the year. But, like, writing in pen, I do not recommend it." -Isabel
Exo-level barriers		
Distractions from personal technology use	Ways that technology distracts students from engaging math in a deep manner; for example, texting friends during class or using math apps to get the answers without learning the steps.	"Interviewer: In an ideal world, you would be most engaged in math if... Carmen: I did not have my phone. I can admit, I use it a lot. But I use it after I'm done with all my work. But I would definitely be a lot more focused if I did not have it with me."
School structures and policies	Ways that students' math engagement was shaped by how math classes are positioned (in terms of schedule and importance) relative to other classes.	"Alan: And most of the time, the [math] homework is not even that big of a priority when other classes you have a lot bigger assignments to work on. Emma: Yeah. I always make math my least prioritized."
Macro-level barriers		
Lack of representation	Ways that students find it hard to engage in math because the people they associate with being good at math do not typically look like them.	"Interviewer: Do you think math people look like you? Carmen: No. Interviewer: No. Why not? Carmen: It's usually a White person"
Math stereotypes and misconceptions	Ways that students find it hard to engage in math because of the way they see themselves or others see them in math.	"I think most people are surprised when they hear that I'm doing good in any class, actually. I'm going to keep it all the way above. I think it's because I'm black. When we talking about GPAs and stuff, they'd be like, 'What's your GPA? I bet it's like a—and then they say a terrible number. I'm like, 'Bro, who do you think I am, bro?'"—Shane
Chrono-level barrier		
Effects of COVID	Ways that students find it hard to engage in math after COVID diminished their motivation for school.	"I felt like since COVID happened, it just—it gave us a lot of slack, like, just sleeping in and not going to wake up, get dressed to go to school, kind of just, it gave us a lot of slack and never really had to tell because it was online. It's not like I can-, you know. I did not really know the teacher's email to ask them."—Alax

slide. I'm like, yeah, I'm not—and then she's like, “We'll come back.” And she never comes back to it.

Shumar (African American, male student in 8th grade): Yeah, she does do that, yeah. Sometimes I get distracted because I want to be able—um, I just like zone out for like, I feel like two seconds, and I look up and then the whole board is covered with a full bunch of different problems.

Jasmine (African American, female student in 8th grade): She's too fast.

Limited teacher support was another related barrier students raised. While related to overall relationships with teachers, this theme focused more on the absence of meaningful academic help. In particular, students described teachers who were not mean or judgmental, but simply did not offer the kind of proactive instructional support they needed, as elaborated by Camilla, Sophia, and Sam below:

Camilla (African American, female student in 6th grade): When I go up to her and ask for her help, she says.

Sophia (African American, female student in 6th grade): She says, “Do it on your own.”

Camilla: Exactly. She says, “Do it on your own,” or, “Figure it out.” I asked for help and she did not help.

Sam (African American, female student in 7th grade): I'll ask for help, and she was like, “You should have known this since last year.

Others shared how long wait times for help could lead to frustration or disengagement:

“This is not necessarily a teacher's fault, but, like, we'll be getting work time, and then if you have a question, the teacher will have to answer, like, everybody else's question before you get to yours. And then, like, then if it's taking so long, like, I'll just put my hand down, and I'll get off task. And I'll just start talking, and then I'll get yelled at, but, like, I was really just trying to get help but it wasn't. It was just taking too long.”—Emma (African American, female student in 10th grade).

Peer challenges also shaped students' engagement in math. Some students shared that they found it easier to stay focused when working independently or when seated away from certain classmates who tended to talk during work time. As Abe (Black/African American boy in 7th grade) put it, “I'm more focused when my friends are not around.” While students valued opportunities to work with others, they noted that group work could sometimes be unproductive—particularly when their peers were not on task or when they were paired with students they did not know well. These situations made it harder to participate meaningfully or get support when needed.

Family obligations and “limited” support at home were additional challenges. Family obligations included taking care of siblings, working to support their family financially, and house chores (e.g., cooking and cleaning), which simply took away the time and capacity that students

could be engaged in math. Students also mentioned that sometimes their parents cannot support them in the traditional sense (e.g., help with homework) because the math they are learning has surpassed their parents' or is taught in a different way. Nonetheless, as we will discuss in the assets section, parents are supporting their children in other forms.

Lastly, *lack of basic resources*, though mentioned less frequently, also surfaced as a meaningful barrier. Some students talked about not having basic supplies like pencils or notebooks, while others said it was hard to focus when they were tired or had not eaten. These small but significant factors sometimes made it difficult to participate fully in class.

Together, these micro-level barriers highlight how everyday interactions at school and home—especially with teachers, peers, and family—shape students' opportunities to participate meaningfully in math learning.

Exo-level barriers

Two main barriers emerged at the exo-level—contextual factors that students experienced indirectly through the systems and structures around them. These included *distractions from personal technology use*, and *school structures and policies*. Students were open about how being on their phones or receiving constant notifications made it difficult to focus during math class. While they chose to use technology resources—such as smartphones and apps like Photomath or ChatGPT—these tools exist within a broader digital environment shaped by what's readily available in and outside of school. Students shared that this environment, often outside of students' direct control, can make it harder to stay engaged or develop a deeper understanding of math concepts. Relying on these tools for quick answers might offer short-term help, but often limited students' deeper understanding of math concepts.

In terms of school structures and policies, students described how it was difficult to stay focused in math class when it was held too early in the day, scheduled back-to-back in long block periods, or placed after particularly demanding classes. Some also noted that by the time they got to math, they already felt mentally exhausted. In addition to scheduling concerns, students discussed school policies—such as large class sizes or grading systems where math homework counted very little—as factors that shaped how much effort they put into math. For example, Alan and Emma described how competing priorities made math less urgent:

Alan (Black/African American, male student in 10th grade): And most of the time, the [math] homework is not even that big of a priority when other classes you have a lot bigger assignments to work on.

Emma (African American, female student in 10th grade): Yeah. I always make math my least prioritized.

These exo-level barriers point to how seemingly rather distant contextual factors—like schedules, grading systems, and technology use—can affect students' ability to stay focused and prioritize math.

Macro-level barriers

At the macro level, students discussed two interconnected challenges—broader cultural and societal messages that shape students'

perceptions of who belongs in math and what math is for. These included *lack of representation* and *math stereotypes and misconceptions*. Lack of representation came up when students reflected on who typically teaches math and who is most visible in advanced math classes. Several students noted that all their math teachers had been White, and some shared that they rarely saw Black or Latina/o students in higher-level math courses. When asked to describe “math people,” some students responded that “it’s usually a White person” and “it’s normally not a Black or Hispanic person.” These patterns shaped how students viewed themselves and others in relation to math and raised questions about who is expected to succeed in the subject.

Relatedly, math stereotypes and misconceptions further influenced students’ engagement. Students talked about assumptions—often related to race—that others made about their academic performance. For example, Shane described being met with surprise when he shared that he was doing well in his classes, attributing the reaction to being Black. In his words:

“I think most people are surprised when they hear that I’m doing good in any class, actually. [...] I think it’s because I’m Black.” – Shane (Black, male student in 9th grade).

Other students echoed these experiences. Yussuf (Black, male student in 8th grade), for instance, talked about how conversations about grades with peers of different racial backgrounds sometimes felt uncomfortable, leaving him to wonder whether bias played a role.

With respect to math misconceptions, some students described how math felt disconnected from their own lives and goals. Lauren, for example, remarked, “I do not think I’m just going to stop in the middle of the day to break down the quadratic formula.” Similarly, Jacob (Black, male student in 8th grade) talked about being “uninterested if I cannot think of a way to apply it to the real world.” Other students, like Eric and Neymar (Hispanic, male students in 9th grade), emphasized that if math felt more useful—especially in relation to future jobs or everyday situations—it might encourage more effort and interest. Together, these macro-level themes reflect broader messages students receive about who belongs in math and whether math feels meaningful to their lives—factors that shape how they approach math learning and participation.

Chrono-level barrier

One barrier that surfaced over time was the lingering *effect of the COVID-19 pandemic*. This theme reflects the chronosystem level, as it captures how students’ math engagement was shaped by significant life events and transitions occurring across time. Students described how the shift to online learning made it harder to stay motivated, build academic habits, and connect with teachers. These effects did not end when schools reopened. For some, group work—now a common feature in math classrooms—became more difficult, while others said they were less likely to speak up or ask for help than before.

Emma (African American, female student in 10th grade): Like, if COVID never happened because I feel like that kind of, like, affected things.

Alax (Black/Hispanic, male student in 10th grade): I felt like since COVID happened, it just—it gave us a lot of slack. We never really had to tell because it was online.

Across these levels, Black and Latina/o students described a complex web of barriers that impacted their math engagement—shaped by relationships, school conditions, structural norms, and lived experience. These barriers often left students feeling judged, discouraged, or unseen. In the next section, we explore the strategies and strengths students used to navigate these challenges.

Navigating barriers using strength-based strategies and assets

To answer research question 2—what strength-based strategies and assets Black and Latina/o students draw upon to stay engaged in math—this section highlights how students navigated the barriers they encountered. These findings are organized using the same ecological framework as before, with an added *intrapersonal level* to reflect self-directed strategies and internal motivations. No macro- or chrono-level responses emerged, as students focused on actions and supports that were immediate and within their control—such as their own habits, classroom interactions, and relationships. Table 3 summarizes the major themes, definitions and illustrative quotes related to these strength-based strategies and assets.

Intrapersonal-level assets and strategies

Students described three self-directed assets and strategies that helped them navigate common classroom challenges. These themes reflect the intrapersonal level, capturing students’ internal resources that they used to support their own math engagement. One theme, *study strategies*, reflected students’ intentional efforts to stay focused and productive, especially in distracting environments. These strategies included setting boundaries with peers, finding quiet places to work, using time management techniques, and knowing when to take breaks. For instance, Brian (Hispanic, male student in 8th grade) shared that “sometimes, my friends are talking to me. I would, like, zone them out and, like, pay attention,” while another student (Evan; Black, male student in 10th grade) emphasized that making the choice to move seats was a way to take ownership over their learning.

Another theme was *sense of success*. For many students, engagement in math grew when they felt competent and confident—even briefly. Bob explained how this feeling helped him reframe math as something meaningful, saying:

“Knowing how to do problems really well really, like, engages me personally... it’s like a reason to do it, like, other than you have to.”—Bob (Hispanic/Latino, male student in 9th grade)

This sense of success wasn’t only about performance; it was also about discovering personal relevance and capability. Willow and Vanessa, for example, highlighted how math offered multiple ways to reach a solution, allowing them to feel capable in their own ways:

Willow (German/Spanish/Swedish/Native, non-binary student in 7th grade): I like how with math, there are just so many different ways you can figure out the answer... There’s like five other methods you can try out.

TABLE 3 Navigating barriers using asset/strength-based strategies.

Theme	Definition	Illustrative quote
Intra-personal level strength-based strategies		
Study strategies	Ways that student use positive study strategies to minimize distractions and thus engage in math	“Sometimes, my friends are talking to me. I would, like, zone them out and, like, pay attention”—Brian
Sense of success	Ways that student’s sense of success after completing a math problem serves as positive motivation for them to engage in math	“Last year, I had, like, a really, really high A, like, really close to 100%. And I was, like, really engaged in it, like you said, like, not just, like, doing it but, like, almost, like, being excited to, like, finish the problem, you know, like I know how this is going to be done. So I just want to do it ‘cause, like, I know how to do it. So knowing how to do problems really well really, like, engages me personally because, like, then—I do not know, uh, purpose is not the right word but it’s, like, a reason to, like, do it, like, other than you have to, like, you know?”—Bob
Math utility	Ways that students engage in math because they see how math is useful for their interests, futures, or everyday lives.	“The beginning of the year was, like, you review stuff. And I was, uh, like—I was asleep during classes. But, after, like, they started getting into, like, stuff that, that, that we need to take in our life—in our lives. I started, like, like, focusing more. And I started engaging.”—Abe
Micro-level strength-based strategies		
Interactive instruction	Ways that students engage in math because it is taught in an interactive (e.g., hands-on, kinetic, gamified) manner.	“When I’m engaged the most is, like, when there’s, like, a variety of things that we are doing. Like, teachers will sometimes, like, just do the same thing over and over and over again. And it will just get boring but, like, then there’s teachers more like—they make coloring sheets out of, like, solving math problems. Or, like today, we played Bingo with math problems. When we are doing, like, whole class learning, we would write on our desks with, like, whiteboard markers.”—Isabel
Teacher support	Ways that students engage in math because of teacher (aid)’s support, including individual help, encouragement, emotional support, etc.	“Even though it’s like your 100th question in the row, she’s (math teacher) still going to help you.”—Kimberly
Positive teacher-student relationships	Ways that students engage in math because of the positive experiences and interactions with their math teachers.	“I think what really makes, like, a teacher—like, makes the classroom nicest [is] when they try to get to know you.”—Helena
Peer support and collaborative learning	Ways that peers support and work with each other to engage in math.	“Me and my friend, we always help each other because we ask our teacher to sit next to each other because we know how to help each other in the ways that both of us know. And then one of us is wrong, but the other one will know what to do. So it’s really fun and you learn faster with them.”—Bella
Family support and capital	Ways that family members provide encouragement, offer help, hold high expectations, serve as inspirations/role models, and reinforce mindsets that support math engagement.	Engage me to be better as a person and to make me and my family proud. I also try because my family did not graduate, like, my parents. So me knowing math, I could help them. So that’s what makes me, like, be focused on math. – Jess
Exo-level strength-based strategies		
Good use of technology	Ways that technology facilitates student’s math engagement; for example, using math apps to receive detailed support that otherwise would not be available.	“Michaela: I used to use my phone, and I know teachers in the school is completely against Photomath, but that app actually kind of helps me because it breaks literally every single step. Lily: It shows you the steps on how to do it, yeah. So that was really helpful.”

Vanessa (Mexican, female student in 7th grade): Just getting the answer, knowing that I could do it... I would just be surprised that now I can do that easily.

These reflections suggest that feeling successful in math wasn’t about always knowing the right answer immediately—it was about the process, growth, and creative problem-solving. These experiences helped counteract barriers related to pacing, confidence, and lack of clarity in instruction.

A third intrapersonal theme was *math utility*—how students saw math connecting to real-life goals, interests, or responsibilities. For students who had previously questioned the relevance of math

(as noted in macro-level barriers), finding practical or personal meaning made the subject more engaging. Shane, for instance, connected math to playing basketball, describing how time and score calculations relied on math skills. Similarly, Abe (Black/African American boy in 7th grade) shared that once the content felt tied to “stuff we need to take in our lives,” he became more invested in class.

Together, these intrapersonal strategies and assets reveal how students actively made math matter to them—whether through focus, purpose, or real-world relevance. They offer a window into the resourcefulness students used to persist despite everyday barriers like distractions, discouragement, or doubts about math’s value.

Micro-level assets and strategies

At the micro level, five key themes supported students' math engagement—assets rooted in students' direct interactions with teachers, peers, and family members within their everyday school and home environments. These included interactive instruction, teacher support, positive teacher–student relationships, peer support and collaborative learning, and family support and capital. These often directly contrasted with barriers students described, showing how the same settings that posed challenges could also foster engagement when conditions were more supportive.

One of the most commonly mentioned assets was *interactive instruction*. This included hands-on activities, movement, games, and lessons with variety—each standing in contrast to the lecture-based styles that many students had described as boring or hard to follow. Isabel explained:

“We played Bingo with math problems. When we're doing, like, whole class learning, we would write on our desks with, like, whiteboard markers.” – Isabel (Mexican/Hispanic, female student in 9th grade)

These kinds of activities helped students stay involved, especially those who had previously shared how they struggled to stay focused during long lectures or when the teacher moved too fast.

Teacher support was another central theme. In contrast to comments about teachers being unavailable or not proactive, students described what effective support looked like: breaking down problems, showing steps clearly, encouraging questions, and offering emotional encouragement. One student (Kimberly; Mexican, female student in 7th grade) described a teacher who helped even with the “100th question in a row,” showing the kind of patience that helped them stay engaged.

Closely connected was *positive student–teacher relationships*. Whereas students described how dismissive or impatient interactions made it hard to ask for help, here students shared that when teachers took time to build relationships, it made a real difference. Helena shared:

“What really makes a teacher... makes the classroom nicest is when they try to get to know you.” – Helena (African American, female student in 8th grade)

Students also described teachers who started class with fun facts or emotional check-ins—small actions that helped build trust and made students feel cared for. These connections helped offset barriers around feeling judged or unsupported.

Beyond teachers, students also leaned on their peers as assets. The theme of *peer support and collaborative learning* captured how classmates helped each other understand content, stay motivated, and feel emotionally supported. Peer support took several forms—from offering clarity during challenging lessons to providing encouragement or simply helping each other stay on task. London captured the idea that sometimes, peers could break things down in ways that felt more accessible than teacher explanations:

“Sometimes I also feel like, kids understand it better when it's coming from their friends. Sometimes their friends can explain it better than the teacher can at times.” – London (African American, female student in 10th grade)

Students who felt highly engaged in math also described being in mutually supportive relationships, where they could both offer and receive help. For example, Bella emphasized how sitting next to her friend made math more collaborative and enjoyable:

“Me and my friend, we always help each other because we ask our teacher to sit next to each other because we know how to help each other in the ways that both of us know. And then one of us is wrong, but the other one will know what to do. So it's really fun and you learn faster with them.” – Bella (Hispanic Ecuadorian, female student in 6th grade)

Beyond academic support, peers were also a source of motivation and emotional reassurance. Jacob (Black, male student in 8th grade) noted that working alongside classmates helped him stay focused and want to keep up. Similarly, Jess and Jacxs described how their table group created a space where they could be both productive and supported:

Jess (Hispanic, female student in 11th grade): In math, I find my friends in that class really helpful and they're always reassuring me if I'm doing okay... we're always finishing our work and helping each other out.

Jacxs (African American, male student in 11th grade): we all can be goofy, but then as soon as, like, time, like, walk in, we all walk in. We all get our stuff done.

These examples show that peers were not just sources of distraction—as some students mentioned as barriers—they were also a critical part of students' learning environments, offering clarity, reassurance, and shared purpose.

This sense of motivation and belonging extended beyond the classroom. Students described drawing on *family support and capital* to stay engaged in math, even when their families could not directly help with math assignments. As noted earlier, many students faced *family obligations* such as caregiving responsibilities, work, or household chores, as well as *limited academic help* from parents unfamiliar with current math content. Yet, rather than framing these circumstances as only obstacles, students also highlighted how their families were a source of emotional encouragement, high expectations, and motivation. In particular, students spoke about family capital—the values, priorities, and aspirations rooted in their home lives—as shaping their commitment to math. Jess, for example, explained how her desire to support her family and become a source of pride fueled her persistence:

“I also try because my family didn't graduate, like, my parents. So me knowing math, I could help them. So that's what makes me, like, be focused on math.” – Jess (Hispanic, female student in 11th grade)

This reflection resonated with her peers, who also described striving to meet expectations and set new milestones.

“Me and my sister was the first one to graduate on, like, my mother's side. And I'm gonna be the second one, with my brother.” – Jacxs (African American, male student in 11th grade)

These examples show how students' math engagement was often tied to their family-oriented identities. Their commitment to learning math wasn't only about individual achievement—it was about honoring their families, giving back, and achieving something meaningful together.

Exo-level assets and strategies

At the exo level, students identified *good use of technology* as a meaningful way to navigate engagement challenges—particularly when classroom instruction fell short or distractions were hard to avoid. While students acknowledged that overusing phones or relying on quick-answer apps like Photomath could get in the way of deeper learning, several also described more intentional and productive uses of these same tools. For example, digital resources like YouTube or Khan Academy helped clarify confusing topics, especially when students did not feel confident asking questions in class. Others turned to Photomath not to copy answers, but to review step-by-step solutions and reinforce what they had missed. These students were not passively consuming information—they were seeking out ways to stay engaged and fill in instructional gaps when support wasn't readily available. As Michaela explained:

I know teachers in the school is completely against Photomath, but that app actually kind of helps me because it breaks literally every single step. – Michaela (Black, female student in 9th grade)

These examples show how students interacted with the broader digital environment in more purposeful ways—using technology resources to supplement instruction and stay on track in their learning. When classroom structures did not fully meet their needs, they turned to online supports to stay engaged and keep trying—demonstrating resourcefulness and persistence even in less-than-ideal conditions.

Discussion

The goal of this study was to understand the barriers that Black and Latina/o students face in their math engagement, as well as the strength-based strategies and assets they draw on to navigate such barriers. Students described barriers across multiple ecological levels—from immediate relationships with math teachers to broader societal messages about who belongs in math—and across different settings, including school, home, and digital spaces. The barriers are not to be taken lightly; they had real effects on students' day-to-day math engagement. For instance, when students noticed that teachers favored some peers over others, it affected their willingness to participate—echoing past research on how perceptions of differential treatment can shape math identity (Berry et al., 2011). Similarly, students shared how stereotypes about who is “good” at math made them feel overlooked or underestimated, which aligns with prior studies showing how youth recognize and respond to racialized narratives about math ability (King and Pringle, 2018; Martin and Fisher-Ari, 2021; Zavala and Hand, 2017). Our findings support Martin et al.' (2010) argument that math is not neutral—ignoring the racialized barriers students face risks adopting a color-blind view of how math learning and engagement unfold.

But the focus of this study was not just on challenges. We aimed to go beyond identifying barriers, for example as inspired by the community cultural wealth model (Yosso, 2005), to examine how Black and Latina/o students actively navigate the barriers. This shift toward a strength-based lens is important because research on math engagement often emphasizes what students from marginalized backgrounds lack rather than what they bring (DePascale et al., 2024; Celedón-Pattichis et al., 2018). This study highlights the internal and external strengths students drew upon—from personal motivation and a sense of success to family values and supportive teachers. Our findings reflect not only the depth of students' resilience but also their agency in shaping how they engage with math. The strategies they described were not reactive or isolated; rather, they reveal patterns of agentic engagement (Reeve and Tseng, 2011; Sengupta-Irving, 2016), which is grounded in students' ability to shape and direct their own learning, often through communal and culturally anchored approaches. In this sense, our findings contribute to the body of literature that uplifts youth from marginalized backgrounds as engaged learners who actively negotiate systemic and structural barriers in math/STEM by drawing upon their cultural funds of knowledge and their forms of relational and communal learning (Calabrese Barton and Tan, 2018).

Importantly, many of the contextual factors students discussed appeared in both the barrier and strategy/asset sections of our findings. This duality reinforces what prior literature has shown: relationships with teachers (Lee et al., 2022; Pianta et al., 2012; Thomas and Berry, 2019), peers, and even technologies like Photomath can either support or hinder math engagement, depending on how they are experienced and used. For example, some students described peers as a source of distraction, while others spoke about classmates as motivators or co-learners. Likewise, technology could lead to mindless shortcuts or serve as a tool for deepening understanding, depending on the context. This complexity matters. It reminds us that engagement does not hinge on a single factor—it's shaped by dynamic interactions between students and their environments. Tying back to our framing, this finding urges us to not see Black and Latina/o students as passive recipients of systemic and structural barriers, but rather as proactive problem solvers who learn to turn the very barriers they face into sources of support and motivation. In a sense, we should go beyond a simple barrier-asset binary and instead focus on understanding the complex processes through which Black and Latina/o students negotiate their math engagement within layered and ever-evolving contexts.

Our analysis also suggests that the barriers and assets are often interconnected. For instance, a student managing responsibilities at home might also experience limited support at school or question their own ability because of broader stereotypes. In response to these overlapping challenges, students described strategies that were often flexible and broadly applicable. Organizing study time, seeking help from peers, or staying focused on personal goals were not limited to one kind of situation, but used across different contexts. While we organized these strategies by ecological level for clarity, students themselves did not necessarily describe them in distinct categories. Their reflections show how they draw on a range of strengths to stay engaged, adapting their approaches depending on the challenges they encounter.

Students primarily described strategies and assets tied to their immediate environments—such as mindset, peer and teacher

relationships, and classroom experiences—rather than broader systemic or structural influences. This focus may reflect their developmental stage and the kinds of challenges they encounter most directly. Still, their reflections offer important insight into the types of support they rely on to stay engaged in math.

Implications for practice

Taken together, our findings align with the call to conceptualize student engagement more holistically, socioculturally, and critically (Lawson and Lawson, 2013; Wang and Hofkens, 2020). A holistic perspective encourages schools to see engagement as more than student behavior or attention—it's also about whether students have the resources they need to participate. For example, something as simple as coming to school with a pencil or notebook—basic but essential—was tied to whether students could meaningfully engage in math (Martinez and Ellis, 2023).

A sociocultural lens emphasizes the importance of instructional approaches that reflect and build on students' lives and experiences. Tying back to our community cultural wealth framing (Yosso, 2005), the first step in engaging students from marginalized backgrounds is to recognize and uplift the diverse assets they bring into the classroom, which too often get overlooked. Many students in this study responded more positively to interactive, hands-on lessons than traditional lectures—highlighting the need for culturally responsive and engaging math instruction that taps into students' funds of knowledge (González et al., 2001; Thomas and Berry, 2019). Similarly, students' references to family motivation and community pride underscore the importance of affirming familial capital and making space for students' identities and cultural values in math learning (Williams et al., 2016).

Representation also matters. Students' comments about who they see in advanced math classes—and who they do not—underscore the importance of creating inclusive environments where all students can see themselves as capable math learners. This includes recruiting and retaining diverse educators, showcasing relatable math role models, and shifting dominant narratives about who “belongs” in math (Gladstone and Cimpian, 2021; Lee et al., 2022; Martin and Fisher-Ari, 2021; Yonas et al., 2020).

Lastly, a critical perspective asks schools to reflect on their own structures and power dynamics. Students in our study did not always have consistent access to help, and sometimes had to work around instructional barriers. As Gutiérrez (2018) argues, rehumanizing math involves shifting power and authority toward students—designing classrooms where they can shape the learning, not just receive it.

Strengths, limitations, and future directions

One strength of the study is its attention to both contextual barriers and student agency, highlighting how engagement is shaped by systems yet also navigated by youth with intention and care. Our ecological approach surfaced themes and patterns across layered contexts. However, because contexts evolve over time, our study is limited in that it captures only snapshots of how students responded to challenges. Future research could take a more longitudinal or narrative approach to trace how students' math engagement strategies evolve over time or across settings.

Another strength of this study is it being grounded in the voices of Black and Latina/o students. We intentionally did not compare between our Black and Latin/o participants, as our goal was to understand shared challenges and strategies. This scope, though, comes with limitations as we recognize that group-specific experiences exist and deserve further exploration. Future studies might take a more targeted approach to examine whether different student groups experience or respond to math engagement challenges in distinct ways. In fact, our data shows that there are tremendous diversity and nuances even within the Black and Latina/o student groups (e.g., see Table 1 for the various racial/ethnic and gender identities that students self-reported), this calls for studies that take a within-group approach to understand the unique, and often intersecting, lived experiences of students from marginalized backgrounds.

Conclusion

This study adds to a growing body of research that centers Black and Latina/o students' voices, not just to highlight disparities in math, but to better understand how students engage, persist, and succeed in the face of complex challenges. Their perspectives are clear: they are motivated, observant, and full of insight about what helps or hinders them. By listening more closely to their voices—and designing learning environments that affirm their experiences and strengths—we can move closer to creating math classrooms where all students can thrive.

Data availability statement

The data used in this study are not publicly available due to IRB protection.

Ethics statement

The studies involving humans were approved by Child Trends Institutional Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

T-YH: Writing – original draft, Investigation, Writing – review & editing, Methodology, Conceptualization, Funding acquisition, Formal analysis. MY: Conceptualization, Writing – original draft, Investigation, Writing – review & editing, Formal analysis, Funding acquisition, Methodology. SH: Conceptualization, Methodology, Data curation, Supervision, Investigation, Writing – review & editing, Funding acquisition. AS: Validation, Data curation, Writing – review & editing. MC: Funding acquisition, Validation, Writing – review & editing. CK: Validation, Writing – review & editing. OR: Writing – review & editing, Validation.

Adapted Measure of Math Engagement Research Group

The Adapted Measure of Math Engagement Research Group includes six students (Antonio Chavira, Brianna Espy, Ryan Ombongi, Serrah Ssemukutu, Salma Ahmed, and Diamond Tony-Uduhirinwa), five teachers (Nathan W. Earley, Karina Mazurek, Kathleen Morgan, Karla Rokke, and Ashly Tritch), and five researchers (Marisa Crowder, Samantha E. Holquist, Diane (Ta-Yang) Hsieh, Claire Kelley, and Mark Vincent B. Yu).

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/feduc.2025.1645533/full#supplementary-material>

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