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Analysis of Middle School Math Systems

Exploring the factors associated with students' experiences in math classes

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Agenda

- **AMS study**
- **Data sources and research design**
- **Findings**
- **Discussion**

Analysis of Middle School Math Systems

The AMS project studied the efficacy and enactment of middle school math curricula

- **Analysis of Middle School Math Systems**
  - Large, mixed-methods study that aimed to understand:
    - The effectiveness of curricula rated "green" (that is, determined to be high quality) by EdReports in improving student academic performance as compared to curricula rated "non-green"
    - Instructional enactment—how and why curricula transform in teachers' hands
  - -For the enactment study, we collected data from students, classrooms, teachers, and principals, district administrators, and professional learning providers in four urban school districts, in approximately 50 schools
- **We were interested in understanding the experiences of middle school students, particularly students who are Black, Latino, multilingual learners, or experiencing poverty**

This presentation focuses on our exploration of students' math experiences

- **We conducted an exploratory study to understand the relationships between student-, teacher-, and school-level factors and students' experiences in math classrooms using data from the larger AMS study**

Data and Research Design

Data

Sample	Data sources
Core study schools (N=50)	• Student surveys • Teacher surveys • Publicly available school-level data (for example, on prior achievement and demographics)
Deep dive schools (N=12)	• Classroom observations (analyzed using the Mathematics Scan (MSCAN) and Culturally Responsive Mathematics Teaching (CRMT) Observation Tool)

We focus on 5 student-level outcomes

We surveyed over 3,990 middle school students over the 2021-22 and 2022-23 school years about their beliefs about math and experiences in math classrooms, across 5 dimensions:

Measure	Definition
Growth Mindset	The belief that the ability to learn and be successful academically is not fixed and can be developed over time.
Achievement identity	The belief that one can perform well in math.
Math self-efficacy	The confidence to solve mathematics problems and perform mathematics-related tasks successfully.
Math enjoyment	The belief that doing math and being in math class is fun.
Math engagement	Positive and active participation in math class including the desire to meet academic expectations, comply with social and behavioral classroom norms, engage cognitively, and engage emotionally.

We explore the student-, teacher-, and school-level factors associated with these outcomes

Level	Factors (source)
Student-level	• Student demographics and grade level (student survey) • Student-teacher racial match (student survey and teacher survey)
Teacher-level	• Teacher demographics, education, and training (teacher survey) • Teacher beliefs (teacher survey) • Teacher supports and professional development (teacher survey) • Classroom practices (classroom observation data)
School-level	• Curriculum in use (conversations with contacts at district offices) • Prior achievement (EDFacts) • Demographic composition of the student body (Common Core of Data)

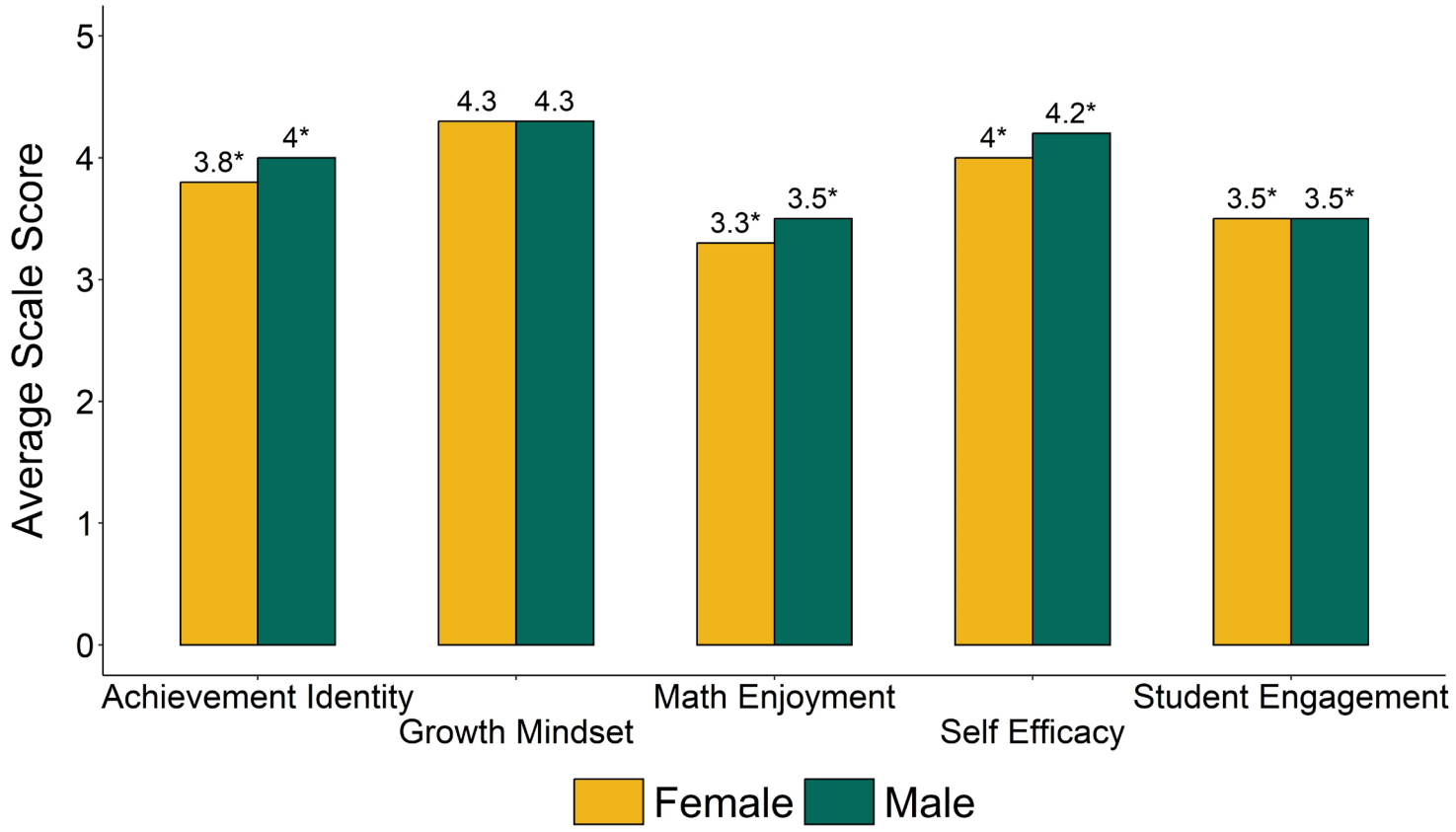
We analyze our data using a regression framework

- **We fit a series of bivariate regression models using each of our predictors with our 5 outcomes of student experiences**
  - **For this presentation, we show descriptive statistics, such as means, to illustrate the bivariate relationships that are statistically significant**

Findings

Female students reported less positive experience relative to their male peers

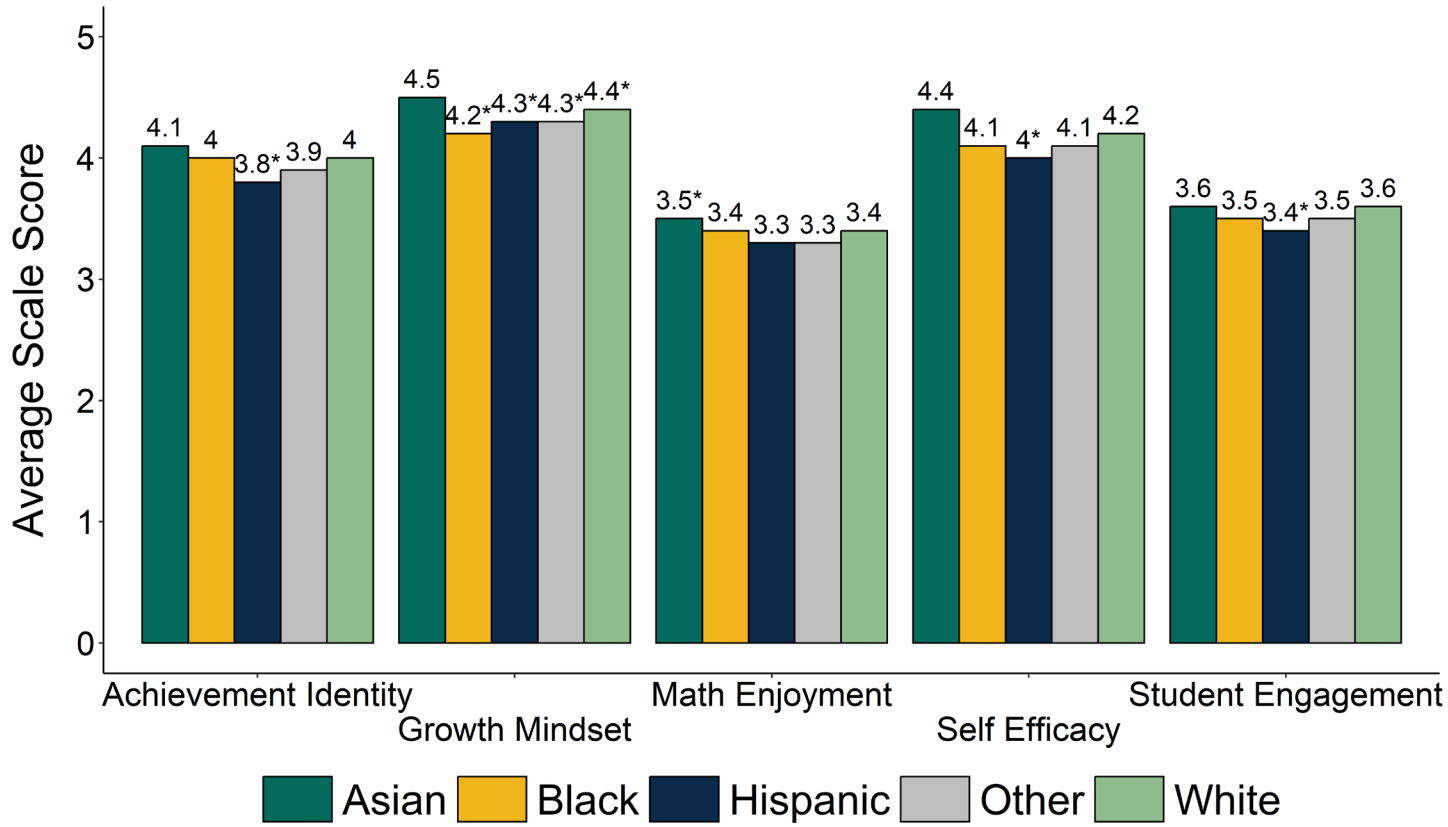
- **Female students reported lower achievement identity, self-efficacy, and math enjoyment relative to male students**



Source: 2022-23 teacher and student survey data

Hispanic students reported worse experience relative to their White peers

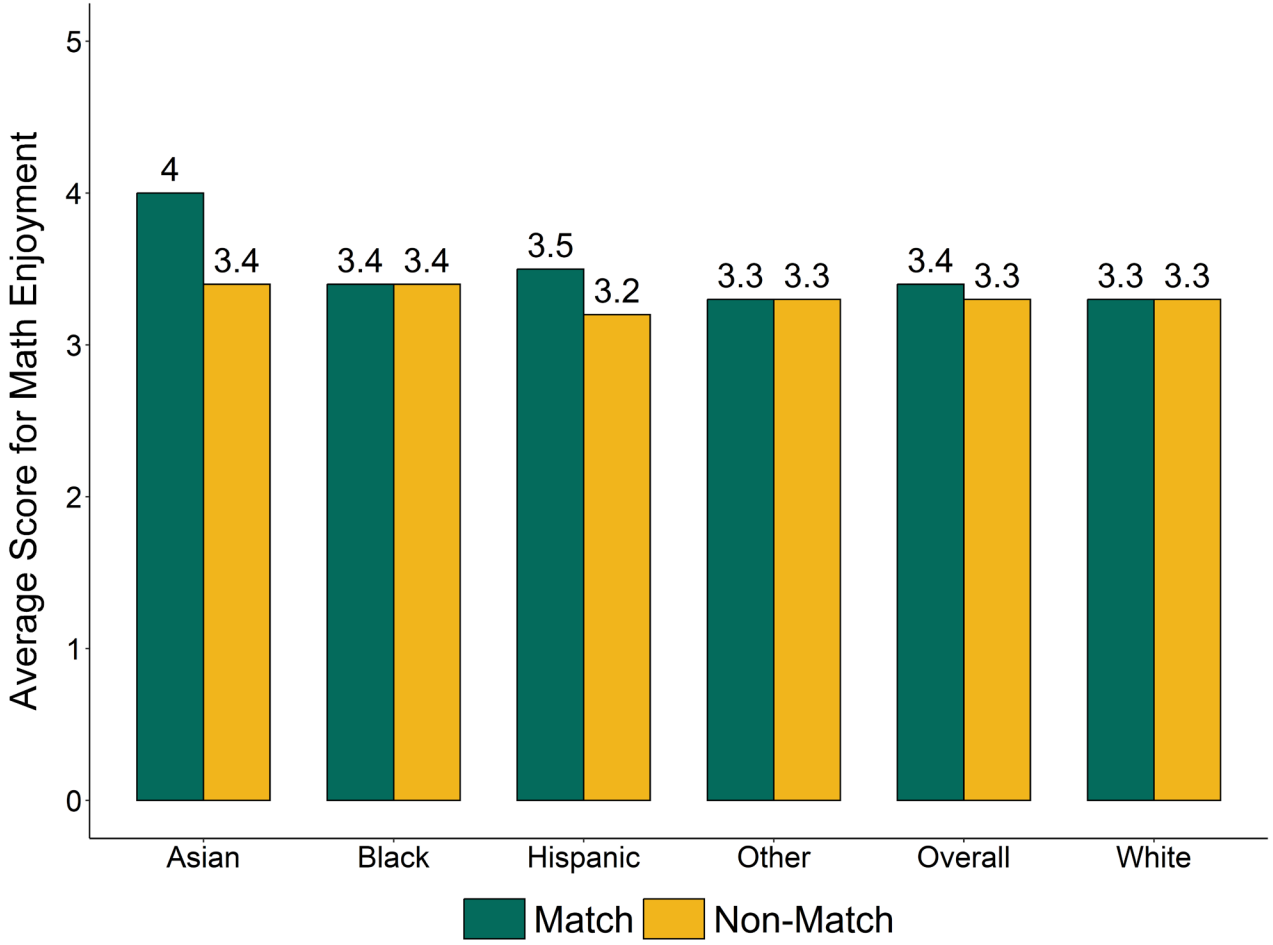
- **Hispanic students reported lower growth mindset, achievement identity, self-efficacy, and student engagement relative to White students**
- **Asian students reported higher math enjoyment and Black students reported lower growth mindset relative to White students**



Source: 2022-23 student survey data

Students with teachers of the same racial/ethnic identity reported more positive experiences in math

- **Students with math teachers of the same race/ethnicity reported more enjoyment of Math, higher achievement identity, and more self-efficacy (albeit slightly lower growth mindset).**
- **These differences were largely driven by Hispanic students, who reported significantly higher scores on all these outcomes when their math teacher also identified as Hispanic**



Source: 2022-23 teacher and student survey data

Students in classrooms that used rigorous and student-centered teaching practices reported more positive experiences

	Growth Mindset	Math achievement identity	Math self-efficacy	Student engagement	Math enjoyment
Measures of rigorous teaching					
Cognitive Demand (M-SCAN)	+	+	+	+	+
Problem Solving (M-SCAN)	+	+	+		
Connections/Applications (M-SCAN)			+	+	
Measures of student centered teaching					
Small-group activities (CRMT)	+	+		+	
Students requesting assistance from their peers (CRMT)		+			+

Examples from teacher practice

Measure	Teachers who scored higher on this measure...	Examples from our observations
Cognitive Demand (M-SCAN)	• Selected math tasks focused on procedures with connections to underlying concepts or non-algorithmic complex thinking	• Students used ratios of water to flour to make cookies
Problem Solving (M-SCAN)	• Asked students to engage in problems that encourage them to grapple with math concepts rather than practicing concepts they already know	• Students struggle with creating inequalities and figuring out which way the symbol should face
Connections/Applications (M-SCAN)	• Asked students to apply math concepts to their own experiences and real-world contexts	• Students connected percent increase and decrease to raises, discounts on shirts, and amount of cereal

Students in classrooms that employed affirming and culturally responsive teaching practices reported better experiences

	Growth Mindset	Math achievement identity	Math self-efficacy	Student engagement	Math enjoyment
Teaching practices					
Giving affirming feedback (CRMT)		+	+	+	+
Setting positive emotional tone (CRMT)		+			+
Scaffolding discourse (CRMT)		+		+	+
Interpersonal connection (CRMT)	+	+	+	+	+
Students engage cultural funds of knowledge (CRMT)	+	+	+		+

Examples from teacher practice

Measure	Teachers who scored higher on this measure...	Examples from our observations
Giving affirming feedback	• Gave students positive, supportive, or constructive feedback on their math-related work or contributions	• Teacher encourages student to explain why they used inverse operations. Student shares response and the teacher responds, “Perfect answer.”
Setting positive emotional tone	• Set positive expectations for the classroom culture/climate by preempting behavioral issues with compassion and empathy or creating a safe emotional space for students.	• Teacher provides procedural clarification by saying, “Don’t forget to attempt every piece. Get the answer to the best of your ability.”
Scaffolding discourse	• Provided math related feedback, ask questions, or models the thinking process to help a student break down a cognitively demanding task	• Teacher is working with a student to solve a problem by asking what they did, restates the operation, and provides feedback on how to set up an equation.

Examples from teacher practice cont.

Measure	Teachers who scored higher on this measure...	Examples from our observations
Interpersonal connection	• Forged or reinforced a personal or relational connection with one or more students via a shared interest, expressing curiosity or appreciation for a student's interest, or engaging with a student in their home language	• Teacher checked in with student privately to ask if they were okay.
Students engage cultural funds of knowledge	• Connected students' community, cultural or linguistic knowledge that is specific to their individual lived experience or local context with a math-related discussion or task	• In a geometry lesson, students are exploring 3D figures and the teacher connects some 3D figures to Amazon boxes delivered to their homes.

Discussion

Discussion questions

- **What can we learn from these findings? What is missing or not captured?**
- **How can we make these findings actionable for teachers?**
- **What are you left wondering after this presentation?**
- **Any other feedback?**

Contact Information

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