

## **Building Mathematical Identity After School: Year 1 of a Cluster-Randomized Trial**

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### **Background**

We are conducting a cluster-randomized trial of an after-school program intended to build mathematical identity among students in groups under-represented in STEM. Populations under-represented in STEM include women, persons with disabilities, African Americans, and Latino/as (NSF, 2011). U.S. jobs are growing most rapidly in areas that require STEM knowledge (National Academy of Sciences, 2010). However, over half of secondary students do not feel they need math outside of school, and they think that liking math is unpopular (Markow & Moore, 2001). If these students continue along this path, they will not be eligible for at least 75% of the jobs of the future (Fleming, 2012). Elementary-level experiences are thus important in attracting students to STEM.

Mathematical identity involves the ways that students think about themselves in relation to mathematics and the extent to which they have developed a commitment to, and have come to see value in, mathematics (Cobb, Gresalfi, & Hodge, 2009). Therefore, it encompasses persistence and interest in mathematics and motivation to learn mathematics. A strong mathematical identity is thought to be key to doing well and persisting in math. Out-of-school-time experiences may build positive math identity in struggling students because pressure to perform for grades and scores is absent. This could translate into higher achievement in school as well. After-school programs may increase students' access to mathematical content and discourse and build identity as knowers/doers of mathematics (Cobb & Gresalfi, 2006). With some exceptions (Berry, 2008; Nasir, 2002), few previous studies examine identity motivation, and fewer yet study out-of-school experiences and identity motivation.

### **Research Questions**

1. What is the effect of the after-school program on students' math identity, engagement, interest, and math achievement?
2. What is the relationship between math achievement and math engagement, interest, and identity in the after-school program?
3. What elements of the program foster students' math identity, and through what mechanisms is this effect achieved? What are the best practices and lessons learned?

### **Setting**

We are implementing the study in 45 after-school programs that serve students in grades 4–5.

### **Intervention**

After-School Math (ASM) is designed to provide engaging, inquiry-based math activities that enhance the key influencers of math identity (see theory of action in Exhibit 1). It has been implemented in diverse sites across the country. Students are exposed to 4 themes: ArtMath, Jump Rope Math, Built Environment, and MusicMath, which take around 12 weeks each to implement. There is one day of educator training for each theme and follow-up support.

### **Research Design**

Programs (minimum 20 students and 2 educators each) are randomly assigned to implement the full ASM curriculum or a control version without activities hypothesized to foster math identity. Implementation of the first two themes occurred in 2016-17, with the last two planned for 2017-18.

### **Data Collection**

Data sources include:

*Student survey of math identity.* This pre/post survey measures students' math identity (see Exhibit 2) and gathers data on students' reactions to the ASM curriculum activities. It was administered at baseline and after each theme.

*Training feedback form.* This form collects after-school educators' immediate feedback on their experiences with the professional development intended to prepare them to lead each theme of ASM. It was administered after training for each theme.

*Educator survey.* This survey captures which activities they completed, challenges, supports for the implementation, and the perceived effect of ASM on students, as well as a version of the survey of math identity that was adjusted to be appropriate for adults who were no longer in school. It was administered after each theme was completed.

*Observation protocol.* The study team adapted the STEM version of the Youth Program Quality Assessment (STEM PQA). It assesses the extent to which activities engage students, build skills, and provide meaningful opportunities to foster math identity. We will conduct observations in 7 treatment and 5 control sites in 2017-18.

*Educator interview protocol.* The interview questions are designed to surface the educator's implementation of the program, as well as perspective on its influence on student math identity. It also include items about educators' own perceptions of math identity.

*Achievement.* We will obtain student pre- and post-program math achievement test scores.

### **Analysis**

We have analyzed all Year 1 data descriptively and will conduct impact analyses in fall 2017. The impact analyses will use a 2-level model. At level 1, we will control for student-level characteristics (baseline math identity, prior achievement, demographics). At level 2, we will control for program covariates. We will also conduct subgroup analyses to look at impacts for girls and minority students.

### **Findings**

Findings from the first year of implementation indicate several challenges. Some sites did not send the required number of staff or did not attend the training. For example, of the 24 programs enrolled at the time of the first training, 2 dropped out of the study before training, and 9 were trained but never implemented, largely due to losing overall program funding and not being able to operate. Several educators reported that they did not implement every activity. Sites that implemented the first theme completely were more likely to complete second theme. Treatment and control sites had similar levels of completion for each theme (range = 71% - 85% of activities), but some treatment sites skipped the treatment-only activities. As is common in after-school environments, students frequently left, joined, or

rejoined the afterschool program. Initial (unadjusted) analyses from the ArtMath pilot theme showed no treatment-control difference in their math identity, although treatment students were more likely say that they had fun and would participate in more activities. Treatment educators reported higher self-perception of math ability after the Built Environment theme. The full paper in spring 2018 will present full, adjust results of impact analyses.

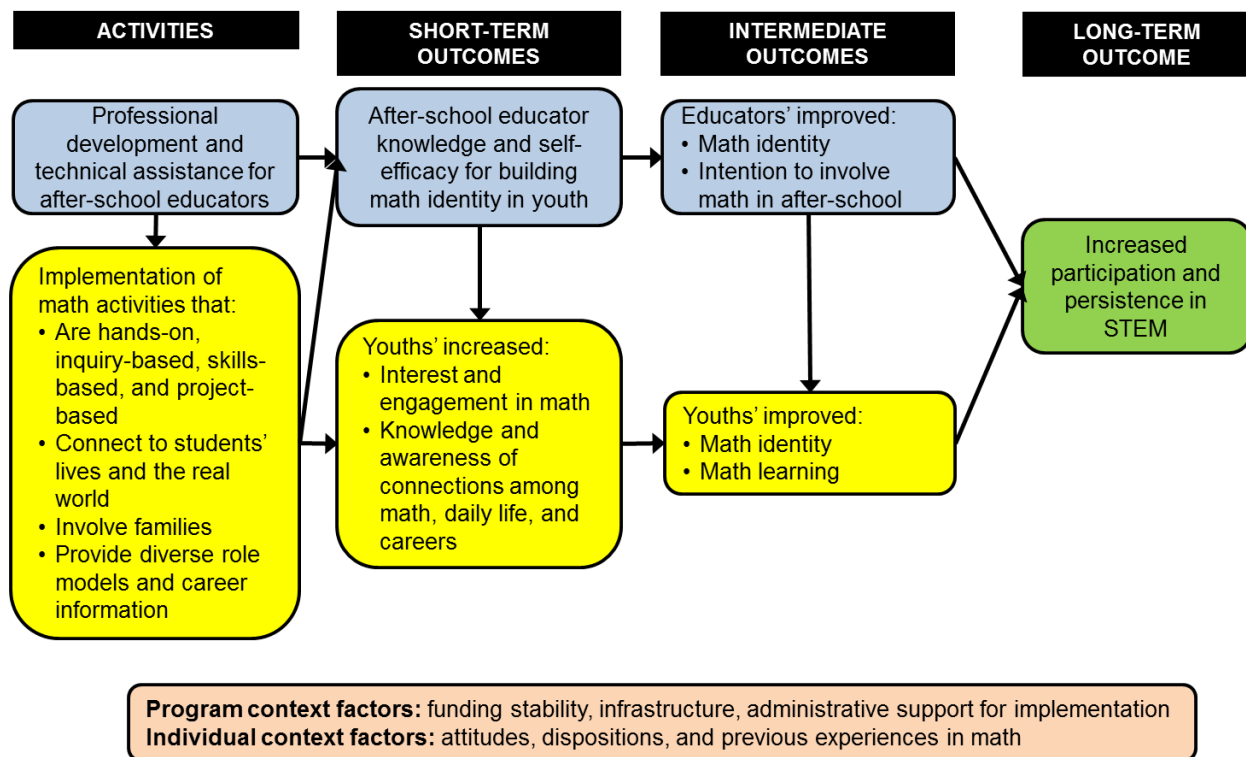
### **Conclusions**

This paper will present first-year findings from an RCT of an afterschool curriculum designed to improve students' math identity. Preliminary analyses indicate no impact on student outcomes and some impact on educator outcomes. There were substantial challenges to implementation. Fall 2017 will include adjusted impact estimates and psychometric analyses of the math identity instruments.

## References

- Berry, R. Q. (2008). Access to upper-level mathematics: The stories of African American middle school boys who are successful with school mathematics. *Journal for Research in Mathematics Education*, 39(5), 464-488.
- Cobb, P., & Gresalfi, M. (2006). Cultivating students' discipline-specific dispositions as a critical goal for pedagogy and equity. *Pedagogies: An International Journal*, 1(1), 49-57.
- Cobb, P., Gresalfi, M., & Hodge, L. (2009). "An interpretive scheme for analyzing the identities that students develop in mathematics classrooms." *Journal for Research in Mathematics Education*: 40-68.
- Fleming, J. (2012). *Enhancing minority student retention and academic performance: What we can learn from program evaluations*. Hoboken, NJ: Jossey-Bass/Wiley.
- Markow, D. & Moore, K. "Progress Toward Power: A follow-up survey of children and parents attitudes about math and science." *NACME Research Letter* 9(1).
- Nasir, N. S. (2002). Identity, goals, and learning: Mathematics in cultural practice. *Mathematical Thinking & Learning*, 4(2/3), 213-247.
- National Academy of Sciences (2010). *Rising above the gathering storm, revisited: Rapidly approaching category 5*. Washington, DC: The National Academies Press.
- National Science Foundation. (2011). *Women, minorities, and persons with disabilities in science and engineering*. Washington, DC: Author.

### Exhibit 1: Revised Theory of Action



### Exhibit 2. Student Math Identity Survey – Subscales, Sources, and Samples

Subscale	Source	Sample Item
Math usefulness (12 items)	Modified Fennema-Sherman Math Attitude Scale - Usefulness (Mulhern & Rae, 1998)	Math is a worthwhile, necessary subject.
Self-perception of math ability	Math and Me (Adelson & McCoach, 2011)	I am really good at math.
Math enjoyment		Math is fun.
Member of math community	Researcher-developed	People like me do math.
Future math plans	Researcher-developed	I plan to use math in my future career.
Growth mindset	Becoming Effective Learners Survey (Farrington, Levenstein, & Nagaoka, 2013)	My intelligence is something I can't change very much. (reversed)