

Background/Context

In 2016–2017, we conducted an experimental RCT field study of our early mathematics intervention, *Young Mathematicians (YM)*, engaging teachers, families, and children from 66 diverse Head Start preschool classrooms (where 65% of children identified as Hispanic/Latinx). The study examined the effects of two interventions (a classroom math-only intervention and a classroom+family math intervention) on preschoolers' mathematics learning, compared to a business-as-usual comparison group. The cross-context intervention (classroom+family math) had a statistically significant effect on Head Start preschoolers' mathematics learning, teachers' instructional practice, and families' attitudes toward mathematics (Young, Reed, Rosenberg, & Kook, 2019). Additionally, the cross-context intervention was particularly effective for older preschoolers (50+ months), with an effect size of $d = .39$. This effect size is particularly meaningful when the intervention is put into context. This intervention was relatively “light touch” and low-cost—14 hours of teacher PD, 7 mathematics games, 15 family mini-books, and 4 family mathematics games—and all materials can be downloaded at no cost from the YM website. While several high-quality, full-year comprehensive preschool mathematics curricula have found effects ranging from .35 to .69 (e.g., Klein, et al., 2008), many preschool centers are resistant to implementing comprehensive mathematics curricula because of competing priorities for classroom time, cost, or limited time and money to provide PD. This results in a gap in which many teachers don't have high-quality mathematics resources to use in their classrooms and have limited training on how to plan and implement lessons. Our new study will address the critical need for innovative resources that transform the mathematics learning environments of preschool children from underresourced communities.

Purpose/Objective/Research Question

Preparation for the STEM-workforce must start early, as young children's mathematics development undergirds cognitive development, building brain architecture, and supporting problem-solving, puzzling, and persevering, while strongly impacting and predicting future success in school. Despite agreement about the importance of mathematics-rich interactions for young children's learning and development, most early education teachers and families are not trained in evidence-based methods to facilitate these experiences, making preschool learning environments (school and home) a critical target for intervention. The benefit of this work is that it will give the field a robust model for a school-based intervention in early mathematics instruction that has the potential to broaden participation by providing instructional materials that support adult-child interaction and engagement in mathematics, explicitly promoting school-home connections in mathematics, and addressing educators' and families' attitudes toward mathematics, while promoting children's mathematical knowledge and narrowing opportunity gaps.

Setting

This project will impact over 50 Head Start teachers, 400 preschoolers, and 400 families from underserved communities.

Intervention/Program/Practice

Through a collaboration with teachers and families, and using observational data, we will identify ways to expand, strengthen, and improve the existing materials to promote children's mathematical thinking. We will strengthen and enhance the intervention to include additional

classroom mathematics games addressing new content areas, refining the professional learning course, creating an enhanced teacher guide with home learning links, creating a family guide with additional family games aligned to classroom activities, creating additional short mathematical problem-solving stories (mini-books), and creating a set of short instructional videos that demonstrate the key mathematical features of the games and mini-books for teachers and families. The fully expanded intervention will be carefully developed and refined with input from advisors, teachers, and families and then tested in a broader field study and finalized for dissemination.

Population/Research Design.

Year 1 of this 4-year effort will focus on materials design and development working closely with a large urban Head Start program in the Northeast, which serves economically disadvantaged families with 85% of children being DLLs of Spanish and English. Project staff will work closely in 5 classrooms with teachers and preschoolers ages 3–5 to test the classroom materials. Ten families from these classrooms will test the materials, participate in observations, and participate in an advisory team. *Year 2* will be an implementation study that ensures the classroom and family mathematics materials and resources are engaging, usable, and comprehensible to preschoolers, teachers, and families. Ten teachers will implement the intervention, and a random sample of two families from each classroom ($n=20$) will be selected for more in-depth qualitative observations and interviews. Teachers will attend PD sessions to support their knowledge of early mathematics, learn the games, address attitudes toward mathematics, and inform implementation and family engagement strategies. In *Year 3*, we will conduct an experimental (RCT) field study with 40 Head Start classrooms to measure the impact of YM on preschoolers' mathematics learning compared with a business-as-usual (BAU) condition. The goals of the field study are (1) to examine implementation in classrooms and at home; (2) to examine the evidence of promise for 400 preschool children's mathematics learning; and (3) to investigate the impact of the intervention on teacher and family attitudes toward mathematics. *Year 4* will focus on analysis and finalizing the classroom and home materials for broader use and dissemination.

Data Collection and Analysis

We will use both qualitative and quantitative research methodologies, integrating data from multiple sources and stakeholders. Our program strives to promote strong school-family partnerships and parent-child communication, and to support parents—in ways that they help design—to extend children's learning at home. A key part of the proposed work is close collaboration with teachers, adult family members, and children through formative research to co-create, test, and re-design mathematics activities that are engaging and enjoyable for families. We will be guided by families such that their “funds of knowledge” (Moll, 2005) to improve both the quality and the relevance of the materials. Specifically, we will: 1) engage in a materials design and development process that includes an iterative analysis cycle of design, development, and implementation, collaborating with practitioners and families in real-world settings; 2) collect and analyze data from Head Start classrooms implementing the mathematics materials to ensure that the classroom and family mathematics materials and resources are engaging, usable, and comprehensible to preschoolers, teachers, and families; and 3) conduct an experimental field study to measure the impact of the intervention on preschoolers' mathematics learning.