The Building Blocks and TRIAD Early Mathematics Projects

Background

Early mathematics is surprisingly important. Children's early knowledge of mathematics strongly predicts their later success in mathematics. More surprising is that preschool mathematics knowledge predicts achievement even into high school. And most surprising is that it also predicts later reading achievement, even better than early reading skills. Mathematical thinking is cognitively foundational. Given the importance of mathematics to academic success in all subjects (Sadler & Tai, 2007), all children need a robust knowledge of mathematics in their earliest years.

The good news is that children as young as ages 3–5 have the potential to learn mathematics that is surprisingly complex and sophisticated. Unfortunately, this potential is left unrealized for many children throughout the world—especially for children from low-resource communities. They have the same implicit understanding of mathematics as their higher-income peers but have not had the opportunities to think and talk about mathematics explicitly—that is, to learn the *language* of mathematics.

With funding from the NSF, the Building Blocks project achieved its goal of helping children find the mathematics in, and develop the mathematics from, their everyday activities—from art and stories, to puzzles and games. Comprised of print materials, software, and more, *Building Blocks* is designed to help children learn number concepts, such as counting, basic arithmetic, and spatial and geometric concepts and processes. *Building Blocks* helps all children learn to mathematize their informal experiences by understanding and talking about them. If they do not learn to mathematize, lower-income children lose the connection between their informal knowledge and later school mathematics, and the gap between them and their more advantaged peers widens, year after year. Mathematization emphasizes representing and elaborating mathematically—creating models of everyday situations with mathematical objects, such as numbers and shapes; mathematical actions, such as counting or transforming shapes; and their structural relationships—and using those models to solve problems so derived. Mathematizing often involves representing relationships in the situation so these relationships can be quantified. Mathematics in puzzles, blocks, and songs is great. However, if it's "just play with blocks," too often little mathematics is learned.

Documented Results

The project's implementation of the *Building Blocks* curriculum has led to large increases in mathematical knowledge of young children in several small studies. To evaluate *Building Blocks* on a larger scale, a study of 36 classrooms was conducted to understand the impact of these interventions. It was found that *Building Blocks* increased scores on a mathematics achievement test and increased the quantity and quality of the mathematics environment and teaching in all project classrooms, from both low- and middle-income groups.

An example of *Building Blocks* involves using the *Building Blocks* software where children complete puzzles by putting together different 2-D shapes on the computer screen. Children can also make their own puzzles using the shapes. The goal of this activity is to help children see shapes as composed of various parts, a foundational concept of early mathematics. Children can

eventually apply this idea to other part-whole relationships, like counting units that make up a set arrangement or (in language arts) combining letters to create words.

The TRIAD project is a model for successfully scaling implementation of an early mathematics curriculum. A particularly challenging educational and theoretical issue is implementing educational programs across the large number of diverse populations and contexts in the early childhood system in the United States. TRIAD is a research-based model designed to meet this challenge in the area of mathematics, with the intent to generalize the model to other subject matter areas and other age groups. The field needs transferable, practical models and empirical evidence of the effectiveness of these models. The TRIAD model was designed to be a collaborative project among administrators, teachers, and families, and provided on-site classroom support; professional development for teachers, coaches, and mentors; and assessments for research collaborators.

Larger-scale studies of implementing the TRIAD model have shown that scale-up is possible and beneficial for preschoolers from low-resource communities. Teachers achieve high levels of fidelity of implementation resulting in consistently higher scores in the intervention classes on the observation instrument, and statistically significant and substantially greater gains in children's mathematics, again with substantial effect sizes in preschool *and* continuing into kindergarten and first grade, significantly more so in the "Follow Through" condition in which kindergarten and first-grade teachers also received professional development.

Potential Applications
The scale-up work indicates that scale-up of the *Building Blocks* curriculum is not only possible, but effective. Entire districts or schools can use the TRIAD model to improve early childhood mathematics education for young children.

For More Information
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Building Blocks website: http://buildingblocksmath.org.
TRIAD website: http://TRIADScaleUp.org

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