Foundations
What Works Centre for Children & Families

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Intervention website: https://www.mheducation.com/prek-12/program/microsites/MKTSP-TMB03M02.html

GUIDEBOOK INTERVENTION INFORMATION SHEET

Building Blocks and TRIAD

Please note that in the 'Intervention summary' table below, 'child age', 'level of need', and 'race and ethnicities' information is **as evaluated in studies**. Information in other fields describes the intervention as **offered/supported by the intervention provider**.

Intervention summary	
Description	Building Blocks is a preschool mathematics intervention for children between the ages of 3 and 4 years from a disadvantaged background. It is delivered by preschool teachers to children for 15 minutes daily.
Evidence rating	3+
Cost rating	1
Child outcomes	• Enhancing school achievement and employment - Improved maths ability - Improved language ability.
Child age (population characteristic)	3 to 4 years
Level of need (population characteristic)	Targeted Selected

Intervention summary	
Race and ethnicities (population characteristic)	• African American • American Indian • Asian/Pacific Islander • Hispanic • White
Type (model characteristic)	Group
Setting (model characteristic)	• Children's Centre or early years setting • Primary school.
Workforce (model characteristic)	Trained preschool teachers
UK available?	Yes
UK tested?	No

Model description

Building Blocks is a preschool mathematics intervention for children between the ages of 3 and 4 years from a disadvantaged background. It is delivered by preschool teachers to children for 15 minutes daily with the aim of improving mathematics ability, including geometric thinking, spatial skills, measurement, and understanding patterns.

TRIAD (Technology-enhanced, Research-based, Instruction, Assessment and professional Development) is a scale-up model that supports the Building Blocks curriculum via professional development for teachers (including a web application that supports teaching based on learning trajectories), classroom materials, and classroom coaching.

The overall intervention is particularly designed for children who live mainly in poverty and are, therefore, at risk of experiencing difficulty in education.

The maths activities are aimed at moving the children through developmental levels to meet learning goals. They are taught through software and print material. Teacher training sessions are focused on the learning trajectories for each mathematical topic.

Target population

Age of child	3 to 4 years
Target population	Children from disadvantaged backgrounds at risk of poor educational outcomes

Please note that the information in this section on target population is as **offered/supported by the intervention provider**.

Theory of change

Why		Who	How	What		
Science-based assumption	**Science-based assumption**	**Science-based assumption**	**Intervention**	**Short-term outcomes**	**Medium-term outcomes**	**Long-term outcomes**
Disadvantaged home environments can reduce children's school readiness and increase the risk of poor outcomes in mathematics, as well as language and executive functions.	High-quality curriculum-based educational experiences increase young children's mathematics competences.	Children from disadvantaged backgrounds are more at risk of poor outcomes in mathematics learning.	A high-quality taught curriculum in mathematics takes children through learning trajectories to develop their geometric thinking, spatial skills, measurement, understanding of patterns, and other mathematical concepts.	Increased mathematical knowledge.	• Increased language and executive function abilities • Increased school readiness.	Improved academic achievement.

Implementation requirements

Who is eligible?	Children aged 3 to 5 years in preschool, from disadvantaged backgrounds.
How is it delivered?	Building Blocks and TRIAD is delivered over 30 weeks of daily sessions of 15 minutes' duration by trained preschool teachers to groups of children.
What happens during the intervention?	• Software and print material are used to teach mathematical topics. • Children engage in educational activities to increase their knowledge and understanding of topics including geometric thinking, spatial skills, measurement, understanding of patterns, and other mathematical concepts. • The activities are aimed at moving children through developmental levels to meet learning goals.
Who can deliver it?	The practitioner who delivers this intervention is a trained preschool teacher.
What are the training requirements?	The practitioners have two to six days of intervention training. Booster training of practitioners is recommended.
How are practitioners supervised?	It is recommended that practitioners are supervised for a total of 24 hours per full intervention delivery by one host-agency supervisor with eight hours of intervention training.
What are the systems for maintaining fidelity?	Intervention fidelity is maintained through the following processes: • Training manual • Other printed material • Other online material • Video or DVD training • Face-to-face training • Fidelity monitoring.
Is there a licensing requirement?	Yes
***Contact details**	Contact person: Jodi Hammond Organisation: Schools' Learning Solutions Email address: jodi.hammond@mheducation.com Website: https://www.mheducation.com/prek-12/program/microsites/MKTSP-TMB03M02.html *Please note that this information may not be up to date. In this case, please visit the listed intervention website for up to date contact details.

Evidence summary

Building Blocks' most rigorous evidence comes from a cluster RCT conducted in the United States consistent with Foundations' Level 3 evidence strength threshold. It also has two other studies, a cluster RCT and a QED which met the Level 2 evidence strength threshold.

The Level 3 study observed improvements in children's maths and language abilities.

This intervention can be described as evidence-based: it has evidence from at least one rigorously conducted RCT demonstrating a statistically significant positive impact on at least one child outcome.

Child outcomes			
Outcome	**Improvement index**	**Interpretation**	**Study**
Improved maths ability	+26	7.35-point improvement on the Research-based Elementary Math Assessment (REMA) (post-intervention)	1a
Improved language ability	N/A	N/A	1a

Search and review

	Number of studies
Identified in search	15
Studies reviewed	3
Meeting the L2 threshold	2
Meeting the L3 threshold	1
Contributing to the L4 threshold	0
Ineligible	12

Individual study summary: Study 1

Study 1	
Study design	Cluster RCT
Country	United States
Sample characteristics	1,305 children enrolled in pre-Kindergarten schools
Race, ethnicities, and nationalities	• 53% African American • 22% Hispanic • 19% White • 4% Asian/Pacific Islander • 2% American Indian • 0.6% Other.
Population risk factors	The average percentage of free/reduced lunch in participating schools was 85%
Timing	• Baseline • Post-intervention • 1-year follow-up • 2-year follow-up.
Child outcomes	• Improved maths ability (researcher-led assessment) • Improved language ability (researcher-led assessment, post-intervention only).
Other outcomes	None
Study Rating	3 Note that study 1a received a Level 3 rating, while studies 1b and 1c received a Level 2+.
Citations	**Study 1a:** Clements, D. H., Sarama, J., Spitler, M. E., Lange, A. A. & Wolfe, C. B. (2011) Mathematics learned by young children in an intervention based on learning trajectories: A large-scale cluster randomized trial. *Journal for Research in Mathematics Education*. 42 (2), 127–166. Sarama, J., Lange, A., Clements, D. H. & Wolfe, C. B. (2012) The impacts of an early mathematics curriculum on oral language and literacy. *Early Childhood Research Quarterly*. 27 (3), 489–502.

Study 1	
	Watts, T. W., Clements, D. H., Sarama, J., Wolfe, C. B., Spitler, M. E. & Bailey, D. H. (2017) Does early mathematics intervention change the processes underlying children's learning? *Journal of Research on Educational Effectiveness*. 10 (1), 96–115. **Study 1b:** Sarama, J., Clements, D. H., Wolfe, C. B. & Spitler, M. E. (2012) Longitudinal evaluation of a scale-up model for teaching mathematics with trajectories and technologies. *Journal of Research on Educational Effectiveness*. 5 (2), 105–135. **Study 1c:** Clements, D.H., Sarama, J., Wolfe, C.B. and Spitler, M.E., 2013. Longitudinal evaluation of a scale-up model for teaching mathematics with trajectories and technologies: Persistence of effects in the third year. *American Educational Research Journal*. 50 (4), 812–850.

Brief summary

Population characteristics

This study involved 1,305 children in pre-Kindergarten classes across 42 schools in low-resource communities in the Unityed States: 927 children in the Building Blocks schools, and 378 in the control schools. 50% of the sample were boys. The study population was ethnically diverse, with the majority of children identifying as African American (53%), followed by Hispanic (22%), White (19%), Asian/Pacific Islander (4%), American Indian (2%), and Other (0.6%). The average percentage of free/reduced lunch in participating schools was 85%.

Schools were recruited which met two of the following criteria: serving ethnically diverse populations who live mainly in poverty; having a large number of pre-Kindergarten (pre-K) classrooms within elementary schools, with self-contained feeder patterns (a history of preschoolers continuing their education in that school); willingness to ensure that each pre-K classroom would have two internet-enabled computers; willingness to have schools randomly assigned to treatments (thus, not having a single mandated pre-K mathematics curriculum); and not having previously been involved in Building Blocks research or development projects.

Study design

In this multi-site cluster RCT, 42 schools were randomly assigned using a randomised block design to one of three groups: Building Blocks intervention, Building Blocks with a follow-through component, and a control group. For the post-intervention assessment after approximately 30 weeks, both the intervention groups are the same. 26 schools were assigned to the Building Blocks groups, and 16 to the control group. The control group received alternative mathematics curricula.

At baseline, the groups were similar on proportion of free/reduced lunch at the school level, and on REMA scores, at the child level.

Measurement

Assessments took place at baseline, post-intervention, 1-year follow-up, and 2-year follow-up.

At baseline and post-intervention

- **Researcher-led** assessments included the Research-based Elementary Math Assessment (REMA), the Renfrew Bus Story – North American Edition, the PALS-PreK (for letter recognition) and the MCLASS:CIRCLE.

At 1-year and 2-year follow-up

- **Researcher-led** assessments included the Research-based Elementary Math Assessment (REMA).

Study retention

Post-intervention

At post-intervention, 95% (N=1,235) of the sample was retained. There were no differences in pre-test scores between the children who were retained and those who dropped out of the study.

For language measures, the number of children with data available was lower: 1,037 children from 38 schools for letter recognition, and 1,027 children for oral language.

1-year and 2-year follow-up

At 1-year and 2-year follow-up, the three groups were analysed separately. Concentrating only on the Building Blocks no follow-though and control groups, 696 children were retained at 1-year follow-up and 618 at the 2-year follow-up. In total, 74% (N=963) of the sample was retained at 1-year follow-up and 83% (N=1,079) at 2-year follow-up.

Results

Data-analytic strategy

Hierarchical linear models were used to assess the effect of Building Blocks compared to the control group, with Level 1 being child and Level 2 being school. An intent-to-treat approach was used.

Findings

The study observed significant improvements in Building Blocks children's mathematics scores compared to the control group.

Limitations

The limitations which can be drawn from the 1-year and 2-year follow-up studies are limited by methodological issues pertaining to study attrition.

Study 1: Outcomes table

Outcome	Measure	Effect size	Statistical significance	Number of participants	Measurement time point
Child outcomes					
Maths ability	REMA (researcher-led assessment)	g = 0.72	Yes	1,235	Post-intervention
Maths ability	REMA (researcher-led assessment)	g = 0.21*	Yes	618	1-year follow-up
Maths ability	REMA (researcher-led assessment)	g = 0.34	Yes	618	1-year follow-up
Maths ability	REMA (researcher-led assessment)	g = .51	Yes	696	2-year follow-up
Letter Recognition	PALS-PreK MCLASS:CIRCLE (researcher-led assessment)	g = -0.05	No	1,037	Post-intervention
Oral language – sentence length	Renfrew Bus Story (researcher-led assessment)	g = 0.08	No	1,027	Post-intervention
Oral language – information	Renfrew Bus Story (researcher-led assessment)	g = 0.29	Yes	1,027	Post-intervention
Oral language – complexity	Renfrew Bus Story (researcher-led assessment)	g = 0.19	Yes	1027	Post-intervention

* This is for the Building Blocks no follow-through group compared to the control. The effect was greater for the Building Blocks with follow-through group.

Individual study summary: Study 2

Study 2	
Study design	Cluster RCT
Country	United States
Sample characteristics	276 children aged 3 to 4 years in 36 preschool classrooms in the US
Race, ethnicities, and nationalities	• 51% White • 49% African American, Asian/Pacific Islander, Hispanic or Native American (breakdown of data was not available for all preschools).
Population risk factors	• Children were primarily from low-income households • 9 out of 36 pre-schools were Head Start programmes, and 12 were state funded.
Timing	• Baseline • Post-intervention.
Child outcomes	Improved maths ability (researcher-led assessment)
Other outcomes	None
Study Rating	2
Citation	Clements, D. H. & Sarama, J. (2008) Experimental evaluation of the effects of a research-based preschool mathematics curriculum. *American Educational Research Journal*. 45 (2), 443–494.

Brief summary

Population characteristics

This study involved 276 children aged 3 to 4 years across 35 teachers in preschools in New York State, USA. Teachers were recruited from Head Start and state-funded programmes, and from those providing for mixed income families. Eight children were randomly selected from each classroom to participate in the study. Initially, 36 teachers were recruited and 280 children, but one teacher and four children were lost during the first three months of the study, and were not included in the report.

In terms of ethnicity, 51% of children were White, and 49% African American, Asian/Pacific Islander, Hispanic or Native American (breakdown of data was not available for all preschools).

Study design

35 preschool classrooms were randomly assigned to the Building Blocks, comparison or control condition. The classrooms in the comparison group received an alternative mathematics intervention, while those in the control condition received the school's usual maths activities.

Measurement

Assessment took place at baseline and post-intervention.

- **Researcher-led** assessments included the Early Mathematics Assessment.

Study retention

Post-intervention

92% (N=253) of the children in the sample were retained at post-intervention, representing 101 in the Building Blocks group, 101 in the control group, and 51 in the comparison group.

Results

Data-analytic strategy

Hierarchical Linear Models were used to assess the effect of Building Blocks compared to the control condition, with children nested within classrooms.

Findings

The study observed statistically significant improvements in maths ability in the Building Blocks group compared to the control group. The Building Blocks group also outperformed the comparison group, which was also significantly better than the control group.

Limitations

The conclusions that can be drawn from this study are limited by methodological issues pertaining to a lack of clarity in terms of baseline equivalence, and a lack of clarity in terms of intention-to-treat analysis, hence why a higher rating is not achieved.

Study 2: Outcomes table

Outcome	Measure	Effect size	Statistical significance	Number of participants	Measurement time point
Child outcomes					
Maths ability	EMA	d = 1.09	Yes	202*	Post-intervention

Other studies

The following studies were identified for this intervention but did not count towards the intervention's overall evidence rating. An intervention receives the same rating as its most robust study or studies.

Clements, D. H. & Sarama, J. (2007) Effects of a preschool mathematics curriculum: Summative research on the Building Blocks project. *Journal for Research in Mathematics Education*. 38 (2), 136–163. **This study was assessed and received a Level 2 rating.**

Sarama, J. & Clements, D. H. (2002) Building Blocks for young children's mathematical development. *Journal of Educational Computing Research*. 27 (1&2), 93–110.

Sarama, J. & Clements, D. H. (2004) Building Blocks for early childhood mathematics. *Early Childhood Research Quarterly*. 19, 181–189.

Clements, D. H., Sarama, J., Wolfe, C. B. & Spitler, M. E. (2015) Sustainability of a scale-up intervention in early mathematics: Longitudinal evaluation of implementation fidelity. *Early Education and Development*. 26 (3), 427–449.

Bojorquea, G., Torbeyns, J., Van Hoof, J., Van Nijlen, D. & Verschaffel, L. (2018) Effectiveness of the Building Blocks program for enhancing Ecuadorian kindergartners' numerical competencies. *Early Childhood Research Quarterly*. 44 (3), 231–241.

Foster, M. E., Anthony, J. L., Clements, D. H. & Sarama, J. (2016) Improving mathematics learning of kindergarten students through computer assisted instruction. *Journal for Research in Mathematics Education*. 47 (3), 206–232.

Foster, M. E., Anthony, J. L., Clements, D. H., Sarama, J. & Williams, J. J. (2018) Hispanic dual language learning kindergarten students' response to a numeracy intervention: A randomized control trial. *Early Childhood Research Quarterly*. 43, 83–95.

Sarama, J., Clements, D. H., Wolfe, C. B. & Spitler, M. E. (2016) Professional development in early mathematics: Effects of an intervention based on learning trajectories on teachers' practices. *Nordic Studies in Mathematics Education*. 21 (4), 29–55.

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Note on provider involvement: This provider has agreed to Foundations' terms of reference (or the Early Intervention Foundation's terms of reference), and the assessment has been conducted and published with the full cooperation of the intervention provider.