An Examination of the Building Blocks Math Curriculum: Results of a Longitudinal Scale-Up Study

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TRIAD Model

TRIAD = Technology-enhanced, Research-based, Instruction, Assessment, and professional Development

TRIAD is...

- A model for early mathematics curriculum intervention, including
  - Building Blocks
  - Technologies for children and teachers
  - Professional development
  - Complete collaboration
TRIAD means...

Instruction

Curriculum Research Framework

Learning Trajectories

• Three components
  • Goal
  • developmental progression
  • Tasks
• Elaboration…
  • descriptions of children’s thinking and learning in a specific mathematical domain, and a related, conjectured route through a set of instructional tasks designed to engender those mental processes hypothesized to move children through a developmental progression of levels of thinking, created with the intent of supporting children’s achievement of specific goals in that mathematical domain (special issue, MTL)

TRIAD II: Large-Scale Evaluation

• 167 classrooms in 3 states (Nashville, 1 year delayed, 106 here—Kerry will present Nashville!)
• Schools publicly, randomly assigned (randomized block design) to:
  • TRIAD
  • TRIAD—with Follow Through (only Buffalo, Boston)
  • Control

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• Address “deep change” that “goes beyond surface structures or procedures… to alter teachers’ beliefs, norms of social interaction, and pedagogical principles” (Coburn, 2003, p. 4).

• Large research review of elements of successful, engaging instruction

• Fidelity and COEMET (Classroom Observation of Early Mathematics Environment and Teaching)

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**COEMET**

<table>
<thead>
<tr>
<th>Mathematical Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. The mathematical content was appropriate for the developmental levels of the children in this class.</td>
</tr>
<tr>
<td>• The task level of difficulty is consistent with children’s level of thinking and learning.</td>
</tr>
<tr>
<td>• The task is sequenced, corresponding to children’s growing level of thinking.</td>
</tr>
<tr>
<td><strong>Organization, Teaching Approaches, Interactions</strong></td>
</tr>
<tr>
<td>10. The teacher began by engaging and focusing children’s mathematical thinking.</td>
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<tr>
<td>• Directed children’s attention to, or invited them to consider, a mathematical question, problem, or idea.</td>
</tr>
<tr>
<td>11. The pace of the activity was appropriate for the developmental levels/needs of the children and the purposes of the activity.</td>
</tr>
<tr>
<td>12. The teacher’s management strategies enhanced the quality of the activity.</td>
</tr>
<tr>
<td>• Prepared materials ahead of time.</td>
</tr>
<tr>
<td>• Organized children efficiently.</td>
</tr>
<tr>
<td>• Maintained children’s involvement.</td>
</tr>
<tr>
<td>13. The teacher was actively involved in the activity for what percentage of time (not including setup or introductions)?</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

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**Classroom Observation**

• TRIAD sig. more, higher quality math

• TRIAD gained, control lost

• No interaction with school SES or LEP
  (neither did those predict COEMET)
COEMET

- Components TRIAD > Control
- Classroom culture
  - Use of “teachable moments”
  - Environmental signs of mathematics
- Number of SMA_text
  - SMA “quality” score
- Number of computers running Building Blocks software
  - Significant mediators were…

Standard regression analysis was conducted following Pituch, Stapleton, & Kang (2006). Empirical M-test to establish 95% confidence intervals for the ab product, submitting the unstandardized regression coefficients a and b and their standard errors to the PRODCLIN program to determine the significance of indirect effects.

Classroom Culture

- E.g., responsiveness to children
- Use of “teachable moments”
- Personal attributes of the teacher
  - knowledgeable and confident about mathematics
  - showing enjoyment in, and curiosity about, as well as and enthusiasm for, teaching mathematics
Number of Activities vs. Time on Task

- Number of SMAs, just “Time on Task”?  
- Extensive data collection allowed us to compare  
- Number of SMAs sig., but not ToT.

Spillover

- Because in control, could document spillover.  
- Some teachers adopted BB activities and materials.

Fidelity

- Similar to COEMET’s theoretical/empirical structure, but only experimental  
- Generally, good fidelity (“Agree”)  
- Small, ns mediator in HLM  
- Does indicate such a math intervention can be implemented on a wide scale

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Math Assessment

- single instrument
- range of mathematical thinking
- based on learning trajectories’ levels of thinking that build hierarchically on the concepts and processes of previous levels
- created REMA

Rasch Study

- Administered to 720 3- and 4-year-old children from diverse backgrounds
- Estimated item difficulties, fit statistics, reliabilities, and separation indices using Rasch model (Winsteps, Linacre, 2005)

Category structure of verbal counting

- Original:
  0 < 5
  1 to 5
  2 to 10
  3 to 20
  4 to 35+
- Revised
  1 < 5
  2 to 10
  3 to 35+
• Elimination of 37 items that showed poor fit and poor correlation with the scale (e.g., triangles that children could not tell were not congruent)

• were redundant, resulted in

• 199 items (~100 shape distractors) that measured different levels of each developmental progression

• adequately fit the Rasch model

Psychometrics: Reliability

• Separation index for item difficulty calibration—22.38 (item SD Rasch accounts for 22.38 times SDs not); equivalent to Cronbach’s reliability of .99

• Rasch item reliability—.98 (KR-20 on raw scores—.94)
Psychometrics: Validity

- **Content**: Previously discussed; based on research and culturally valued topics
- **Concurrent**: Correlation with CMA—.86
- **Construct**: Fits Rasch model
- **Predictive**: Treatment sensitivity

Did TRIAD Work for Everyone? Interactions of Class Variables

- **School SES** (% free/reduced lunch):
  - Predictor ($p = .001$), but
  - No significant interaction ($p = .08$)
- **School LEP** (% Limited English Proficiency):
  - Predictor ($p = .03$), but
  - No significant interaction ($p = .96$)
Did TRIAD Work for Everyone? Interactions at Child Level

- Child
- Gender: Not significant ($p = .93$)
- Ethnicity: Most not significant...

Conclusions

- TRIAD model successful scaling up LT approach in diverse urban settings with nonvolunteers
- Good fidelity, low variance. Predictive, but largest for lowest 25%.
Conclusions

• Positive effects on math achievement
• One significant moderator: TRIAD’s LTs may be particularly effective in ameliorating the negative effects of low expectations for African-American children’s learning of mathematics (NMAP, 2008).

Conclusions

• COEMET mediator
• Classroom culture (important, as teacher quality affects most in low-SES schools)
• Number of SMA’s
• Number of BB computers
• Again, partial—so curriculum alone

Implications

• Learning Trajectories effective core
• Professionalism based on scientific rather than idiosyncratic personal knowledge
• CRF effective framework
Web Sites (and article download)

UBTRIAD.org
UBBuildingBlocks.org