Efficacy and Effectiveness Studies of the Building Blocks Curriculum and the TRIAD Scale-up Model

Douglas H. Clements, Julie Sarama, Mary Elaine Spitler, Christopher Wolfe, Alissa Lange

Children from low-income backgrounds enter school with far less knowledge...

gap...progressively widens throughout their PreK-12 years”

National Math Panel

“Research that scales up early interventions capable of strengthening mathematical knowledge, evaluates their utility in Pre-K and K, and examines long term effects is urgently needed, with a particular focus on at-risk learners”

TRIAD is...

• A model for early mathematics curriculum intervention, including
  • Building Blocks
  • Technologies for children and teachers
  • Professional development
  • Complete collaboration

Friday, July 22, 2011
Theoretical Framework: Network of Influences Model

1. Involve, and promote communication among, key groups
   - emphasizing a shared understanding of, and connections between, the project’s goals, national and state standards, and greater societal need
2. Promote equity
3. Plan for the long term

10 Research Guidelines

4. Place research-based learning trajectories at the core
   - so that curriculum, materials, instructional strategies, and assessments are aligned with each other, research, standards
5. Build expectation and camaraderie to support a consensus around adaptation

6. Provide professional development that is
   - multifaceted,
   - extensive, ongoing,
   - reflective,
   - focused on common actions and problems of practice and especially children’s thinking,
   - grounded in particular curriculum materials,
   - as much as possible, situated in the classroom.

Friday, July 22, 2011
10 Research Guidelines

7. Give latitude for adaptation to teachers and schools, but maintain follow-through, integrity
8. Maintain frequent, repeated communication
9. Give teachers continuous feedback from sources they trust
10. Provide incentives for all participants

TRIAD means…

Building Blocks

Instruction

Building Blocks In the News

Friday, July 22, 2011
Teachers’ Representations of Learning Trajectories: Developed Simultaneously with BB

Friday, July 22, 2011
TRIAD I: Proof of Concept

Research Questions
- Can Building Blocks be implemented with high fidelity?
- Does Building Blocks have substantial positive effects on the quality of the mathematics environment and teaching?
- On children’s mathematics achievement?

Design
- 36 classrooms, randomly assigned to 1 of 3 groups
- Building Blocks, Comparison, and Control
- 8 focal children, randomly selected
**Results: Child Assessment**

- **p = .000+**
- **T Scores:**
  - 50 Mean
  - 10 SD

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Comparison</th>
<th>Building Blocks/TRIAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>T Score</td>
<td>4.25</td>
<td>8.50</td>
<td>12.75</td>
</tr>
</tbody>
</table>


**TRIAD II: Large-Scale Evaluation**

- **167 classrooms in 3 states** (Nashville, 1 year delayed, 106 here)
- **Schools publicly, randomly assigned** (randomized block design) to:
  - TRIAD
  - TRIAD-with Follow Through
  - Control

**Design**

- 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)

Friday, July 22, 2011
COEMET

Mathematical Reason

9. This mathematical content was appropriate for the developmental levels of the children in this class.
   - Significantly harder for children with lower math reasoning capacity.
   - Significantly easier for children with higher math reasoning capacity.

Organization, Teaching Approaches, Interactions

10. The teacher began by engaging and focusing children's mathematical thinking.
    - Increased children's interaction in asking a question, then discussing it.

11. The pace of the activity was appropriate for the developmental level of the children and for the purposes of the activity.

12. The teacher's management strategies enhanced the quality of the activity.
    - Increased children's interactions.
    - Increased children's engagement.

Components TRIAD > Control

- Classroom culture
- Number of SMA
- SMA “quality” score
- Number of computers running Building Blocks software

Significant mediations 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”
- Environmental signs of mathematics
- 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.

Mediation
- COEMET
  - Classroom Culture, SMA, #SMAs all mediated
  - \( g = .15, .002, .11 \)
- Fidelity
- Correlated, but weak and no mediation

Friday, July 22, 2011
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
  - LT—helps teachers help all students learn

Friday, July 22, 2011
Language and Literacy

Does that area suffer?

Assessments

• Letter Recognition
• Renfrew Bus Story Assessment
  • Retell runaway bus story while looking at the pictures
    - Information
    - Sentence length
    - Complexity
    - Independence
    - Listening
    - Story duration
    - Inferential questions

Results

• Letter recognition: ns
• Bus Story: ns on:
  • Sentence length
  • Listening
  • Story duration

Results

• Sig. higher for TRIAD on:
  • Information
  • Complexity
  • Independence
  • Inferential Questions

Friday, July 22, 2011
Scale Up

- TRIAD model is successful
- PD —> Quality and Quantity of Math (partially) —> Child Learning
- Fidelity/Curriculum —> Child Learning
- Working on sustainability
- Complex model of "core components"

Core: Best Guesses

- Empirically proven (CRF) intervention
- Extensive PD, mentoring
- Try to keep administrators on track (all levels)
  - Either internal commitment on the part of the district or external funds!
- Assessment: See the progress

Follow Through

Friday, July 22, 2011
Mediation

- COEMET
  - Only #SMAs mediated

**Figure: Mediation Graph**

TRIAD Follow Through
TRIAD
Control

TRIAD > Control, ES = .17, ns
TRIAD FT > Control ES = .47
TRIAD FT > TRIAD, ES = .27
(Note: pre-K posttest as covariate)

Conclusions

- TRIAD and Building Blocks can be brought to scale
- Especially important for some subgroups

Friday, July 22, 2011
Necessity of Follow Through
• Only TRIAD Follow-Through maintained gains.
• Common conclusion that preschool effects fade reifies such effects, as if the effects’ independent evanescence could be judged.
• Instead, we believe children’s trajectories must be studied as they experience different educational courses.

Necessity of Follow Through
• Held accountable for largest number passing minimal competency assessments, engendering belief that higher performing are “doing fine.”
• Thus, early gains are “lost.”
• U.S. educational system unintentionally but insidiously re-opens the gap.

Web Sites (and article download)
UBTRIAD.org
UBBuildingBlocks.org