Selected Mathematics Resources
Douglas H. Clements and Julie Sarama

Books


Articles


Websites
Web home page: http://www.gse.buffalo.edu/FAS/Clements/
TRIAD Project: http://www.ubtriad.org/
716-645-2455 (Ext. 1155) for any project
Building Blocks Project: http://www.ubbuildingblocks.org/
Aligning Stage-Appropriate Evaluation with the Stages of Implementation: Ongoing Monitoring and Scale Up/Replicability
Douglas H. Clements & Julie Sarama

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”

- We need early math.
- We need ways to scale up.
- Must be research based.
- What is a research-based intervention?

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The Curriculum Research Framework

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Research Basis

• Many claim a research basis,
  • but claims often vacuous, citing theories or empirical results vaguely.
  • Need framework
    • should require answering scientific questions…

Practice

Policy

Theory

Effect

• Effective in achieving learning goals?
• Credible relative to alternatives?
• Effect size?
• Curriculum goals important?
• Why effective?
• Credible relative to alternatives?

Conditions

• When and where?
• Under what conditions?
• Generalized?
• Support requirements for various contexts?
• Why do conditions increase (decrease) effects?
• How & why strategies produce previously unattained results?

Curriculum Research Framework

• A Priori Foundation
  • General: Broad philosophies, theories, and empirical results
  • Subject Matter
    • substantive contribution, build from past, generative
  • Pedagogical (e.g., computer activities)

• Learning Trajectories
  • Goal, developmental progression, instructional tasks

Curriculum Research Framework

• **Formative Evaluation**
  • Small Group
    • Learning trajectory’s elements evaluated
  • Single Classroom
    • Meaning teachers and students give in progressively expanding social contexts
    • Intended and unintended outcomes; emergent in complex system
  • Multiple Classrooms
    • Diverse group of teachers
    • Support required

• **Summative**
  • Small Scale
    • 4-10 classrooms
  • Large Scale
    • Scale up, studying moderators and mediators for explanatory power (contextual, implementation variables)
    • Fidelity of implementation and sustainability on a large scale (of effects and implementation)
    • Diffusion theory; overlapping spheres of influence models

TRIAD Model

Also from extensive research review…

...adds specificity to diffusion theory and overlapping spheres of influence theory, to maintain the integrity of innovation through increasingly complex socially-mediated filters, throughout phases of introduction, adoption, implementation, and institutionalization.
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

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.

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
Teachers’ Representations of Learning Trajectories: Developed Simultaneously with BB
TRIAD II: Large-Scale Evaluation

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)

COEMET

Mathematical Focus

- The mathematical content was appropriate for the developmental levels of the children in the classrooms.
- The teacher maintained appropriate classroom management.
- The teacher engaged in meaningful mathematical discourse with the students.
- The teacher provided clear explanations and demonstrations.
- The teacher used a variety of instructional strategies.

Organizations, Teaching Approaches, Interactions

*These observations were made by two different observers for each classroom.*

ES = 1.13

Rasch scores p < .0001

ES = 1.13

Fall

Fall Year 2

Spring Year 2

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TRIAD scores

Rasch scores

p < .0001

Follow Through

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

- TRIAD and Building Blocks can be brought to scale
- Especially important for some subgroups
- Follow Through is necessary

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

- Most educational contexts are unintentionally and perversely aligned against early interventions.
- Kndg., 1st grade curricula assume little competence, thus only low-level skills are taught.
- Teachers often required to rigidly follow curricula & remain unaware of what students have mastered…

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
Lessons Learned:
Overwhelming

- Coaches and mentors demonstrate the implementation of all components of the curriculum, doing activities right in the classroom
- Establish a strong, flexible, responsive system of coaching and mentoring

Lessons Learned:
Lack of Time

- Use coaches and mentors to demonstrate, on-site, in real classroom situations, the ease with which these math activities fit into the child’s natural everyday activities, and to the natural routines of the classroom, using traditional early childhood materials (the “ah-ha” moment for teachers).
- Have teachers note, at PD, how long curriculum activities actually take.
- Reassure teachers that time issues fade during the year as teachers get a sense of the actual time demands of the curriculum.
- Have teachers observe other teachers on website teaching activities with an eye on the time.

Lessons Learned:
Diverse Program Schedules

Build flexibility into schedules:
  - half day programs,
  - 4 day per week programs
  - early schools, late schools
  - Other time constraints

Help teachers to recognize and work with this flexibility.

Lessons Learned:
Difficulty of PD Material

- Recognize that teachers, by self-report, have limited math content knowledge (although they report that this limited knowledge is adequate).
- Learning trajectories framework consistent
- Recognize that teachers will find the LTs difficult at first (hate me in Nov. and Dec.); later, the LTs will make much more sense, and become a useful tool for the teachers (love me in Jan. and Feb.).
Lessons Learned: Technological Problems

- Recognize that some teachers have limited technological experience.
- Provide a technical mentor
- Use the “teach a person to fish” rather than the “give the person a fish” approach.

Randomized Trials… and Tribulations

- Teacher sharing
  (We needed the COEMET)
- IRB — Who is the subject?
  (district vs. teacher)
- Principal—My teachers are fine, so…
- Seniority/union rules—teachers moving in the middle; limited observations

Randomized Trials… and Tribulations

- Superintendent change: 2 stories…
  - New American Schools
  - TRIAD in Boston
  - Administration support and stability important

Research Challenges

- Inchoate. Needs testing, elaboration, but…
- Ubiquity and multifariousness of claims
  —“research-based”—discourages science
- Domination of market “research” + post hoc
- Bias against design sciences in academe
- Unfortunate dichotomies (basic/applied, quantitative/qualitative)
- Funding timelines and structures

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Diffusion

• Building Blocks adopted as the official mathematics curriculum for Pre-K in both Boston and Buffalo
• Mentors worked with the same districts
• That work has flourished, with the effect that every preschool teacher in the two city school districts have received the TRIAD intervention, including the Building Blocks curriculum

Diffusion

• Surrounding districts
  • Have begun professional development and implementation efforts

Limitations

• Even districts that helped support the data collection…push to limit the PD and support.

Web Sites (and article download)

UBTRIAD.org
UBBuildingBlocks.org

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