Using Data for Improvement to Support Implementation At-Scale: Adaptive Integration in the TN Mathematics Coaching Project

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Link to full paper

Please see our full paper at:

TN Mathematics Coaching Project

- Test and refine a model for mathematics instructional coaching
  - Resource for schools and districts throughout the state
  - Support the transition to rigorous, college and career ready mathematics standards
- Robust collaboration among three strategic partners
  - Policymakers from the TN Department of Education
  - Researchers from the Learning Research and Development Center, University of Pittsburgh
  - Professional development practitioners from the Institute for Learning
### Problem space

<table>
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<tr>
<th>Challenges associated with instructional improvement at scale:</th>
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## Embracing adaptive integration

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**Adaptive Integration**

Using improvement research methods to integrate standard coaching processes into new contexts.
Challenge & promise of coaching to support high quality mathematics teaching

- Emerging evidence base that coaching can support mathematics instructional improvement (Campbell & Malkus, 2011; Foster & Noyce, 2004; Polly, 2012)
- Coaching varies greatly in the way it is implemented (Coburn & Russell, 2008; Murray, Ma & Mazur, 2009)
- Lack of consensus on effective coaching practices
- Coaching work lies at a critical intersection in the process of policy implementation
  - Boundary spanners between district and school contexts
  - Coaching is shaped by the demands of multiple levels of the educational system
Networked Improvement Communities and Adaptive Integration

- Networked improvement communities (Bryk, Gomez, Grunow & LeMahieu, 2015):
  - focused on a well-specified common aim;
  - guided by deep understanding of the problem, the system that produces it, and a shared working theory to improve it;
  - disciplined by the methods of improvement research to develop, test, and refine intervention; and
  - organized to accelerate interventions into the field and to effectively integrate them into varied educational contexts.

- Adaptive integration, “involves using improvement research methods to integrate a standard work process into new contexts, which is critical for learning how to scale improvements. As an innovation or change that has worked in one context moves into others, improvement methods are used to learn what it takes to make it work under diverse conditions” (Bryk et al., 2015)
Goal of this paper

• Describe an approach to testing, implementing and scaling a promising innovation for instructional improvement: the TN Mathematics Instructional Coaching Model

• Highlight what and how we are learning about the adaptive integration of the coaching model into diverse local contexts
TN Math Instructional Coaching Network

Network Hub: TDOE + LRDC + IFL
- Coordination
- Training and tool development
- Knowledge management
COACHES partner in the continuous improvement of the coaching model:

- Gather and share data about their practice
- Engage in reflective practice
- Generating ways to improve or augment the coaching model for use in their specific local context.
TN Mathematics Coaching Model

State Actions to Spread the Model
- Support a sustainable coach network?
- Other TBD

Districts & School Actions to Implement the Model
- Coach selection processes
- Coach allocation processes
- Coach PD and support
- Coach-principal instructional leadership process

Coaching Model

Coach Development Framework

Coaching Framework (e.g., Feedback Process)

Continuous Improvement (e.g., PDSA inquiry cycles)

Improve Mathematics Teaching
- Build students’ conceptual understanding
- Engage students in productive struggle
- Maintain cognitive demand of high level tasks
- Orchestrate productive classroom discourse

Student Conceptual Understanding of Mathematics & Mathematical Performance Consistent with the TN Standards
Coach-Teacher Discussion Process

① Goal and then Task Selection

Coach & teacher set or clarify the mathematical learning goals

Coach & teacher communicate to select a high level task for the cycle

Coach & teacher independently work out solutions for task prior to planning conference

② Pre-Observation Planning Conference

Coach & teacher schedule pre-observation planning conference within 24-48 hours before lesson

Coach & teacher mark specific pedagogical goals in service of the mathematical goal for the lesson and both commit to working toward the goals

Coach & teacher engage in a deep & specific discussion of the instructional triangle (mathematics content, student thinking & pedagogy)

③ Classroom Observation

Coach observes the teacher teaching the task

Coach & teacher gather evidence related to the mathematical & pedagogical goals

④ Post-Observation Conference

Coach & teacher schedule post-observation conference within 48 hours of observation

Coach & teacher analyze evidence to highlight the goals that were and were not accomplished

Coach provides evidence-based feedback that is contextualized within a larger framework of effective teaching

Coach & teacher co-construct pedagogical goals for next cycle and commit to working toward goals
Data & Improvement Cycles

IMPROVEMENT CYCLE 1
Networking Meeting
Teacher Survey

IMPROVEMENT CYCLE 2
Networking Meeting
Teacher Survey

IMPROVEMENT CYCLE 3
Networking Meeting
Teacher Survey

IMPROVEMENT CYCLE 4
Networking Meeting
Teacher Survey

IMPROVEMENT CYCLE 5
Networking Meeting

IMPROVEMENT CYCLE 6
Networking Meeting

OCT. 2014
DEC. 2014
MAR. 2015
AUG. 2015
NOV. 2015
MAR. 2016
Data & analysis of teaching

SURVEY

• Pre-survey administered in Fall 2014 before coaching (N=64 teachers)
  • Self report of beliefs and practice (e.g., attention to conceptual understanding)
  • Post-survey administered in Spring 2015 after 1 year coaching (N=49 teachers)

VIDEOTAPES

• Videos of mathematics teaching at 3 different time points over 2014-15 school year (N=64 teachers)
  • Coded by experts for the maintenance of the cognitive demand of tasks (Stein & Kaufman, 2010)
# Data & analysis of coaching

<table>
<thead>
<tr>
<th>Key Coaching Practices</th>
<th>In-Depth Measures</th>
<th>Scale Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal Setting (Mathematics &amp; Pedagogical)</strong></td>
<td>Coding types of goals set (performance, learning &amp; pedagogical) Coding the degree to which coaches co-construct the goals</td>
<td>Post-cycle survey items completed by partner teachers (combination of open and closed-ended items about goal setting)</td>
</tr>
<tr>
<td><strong>Evidence-based Feedback</strong></td>
<td>Coding instances of coach feedback in post-observation conferences – qualitative investigation of the characteristics of feedback that engender teacher engagement</td>
<td>Post-cycle survey completed by partner teachers</td>
</tr>
<tr>
<td><strong>Deep &amp; Specific Conversations</strong></td>
<td>3-part coding scheme applied to pre-conference transcripts. Indicators of deep and specific talk about:  - Student mathematical thinking  - Mathematical goals for the lesson  - Pedagogy</td>
<td>Post-cycle survey completed by partner teachers</td>
</tr>
</tbody>
</table>
TRENDS IN TEACHING AND COACHING PRACTICE IN YEAR 1

EVIDENCE THAT WE ARE ON THE RIGHT TRACK
Changes in expert scored video observations

**Signs of Improvement:**
- Mean Improvement
- Decrease in SD
- Fewer Coach Assists in Cycle 3

Paired samples t-test for CD (cyc3-cyc1): \( ES = .24 \)
\( t=1.77~, df=57, p<.1 \)

**Improvement for Whom?**

1. Limited opportunity for Stable High-Enactors
2. Struggling Enactors
   - How many?
3. Improving Teachers
Changes in self reported beliefs and practices

<table>
<thead>
<tr>
<th>Item Description</th>
<th>KEY: **&lt;.01; *&lt;.05</th>
<th>Cycle 1 Mean</th>
<th>Cycle 2 Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>INCREASE in Frequency [3=sometimes; 4=often]</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student work forms the basis for classroom discussion *</td>
<td></td>
<td>3.42</td>
<td>3.83</td>
</tr>
<tr>
<td>Students listen to and critique others' reasoning **</td>
<td></td>
<td>3.38</td>
<td>3.83</td>
</tr>
<tr>
<td>Students generate explanations that focus on underlying justifications *</td>
<td></td>
<td>3.21</td>
<td>3.53</td>
</tr>
<tr>
<td><strong>DECREASE in Beliefs [2=disagree; 3=neither; 4=agree]</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A teacher's main priority is to teach all students the most efficient algorithm to always obtain the correct answer**</td>
<td></td>
<td>2.35</td>
<td>2.06</td>
</tr>
<tr>
<td>Students are not ready for &quot;higher-order&quot; learning until they have acquired the basics**</td>
<td></td>
<td>3.29</td>
<td>2.79</td>
</tr>
<tr>
<td>More important than extended math discussions, students need a lot of practice with math problems*</td>
<td></td>
<td>2.85</td>
<td>2.58</td>
</tr>
</tbody>
</table>
Changes in pre-conference discussions (solution paths)

Depth Discussing Multiple Solution Paths  
(n=64 per cycle)

- Cycle 1
- Cycle 2
- Cycle 3

Average Pre-Conference Score

- All discussed in superficial ways
- One discussed in more than superficial way
- At least two discussed in more than superficial ways

ES = .56/.91 = .62 SD
Changes in pre-conference discussions (math specificity)

Mathematical Goal is Discussed with Specificity (n=64 per cycle)

ES = .53/.71 = .75

Cycle 1

Cycle 2

Cycle 3

ES = .53/.71 = .75

Discussion of students acquisition of the underlying meaning of a concept

Gives a mathematical definition or a procedure as the goal

Broad topics named

Discussion of students acquisition of the underlying meaning of a concept

Gives a mathematical definition or a procedure as the goal

Broad topics named
Coaches Adapt to Teacher Responsiveness

ADAPTIVE INTEGRATION IN ACTION?
Teacher Responsiveness:
Primary *Independent Variable*

**Coach Report Options:**

- (1) Teacher exhibited behaviors that signaled explicit resistance;
- (2) No explicit resistance but teacher was not prepared and/or signaled low engagement;
- (3) Teacher was compliant, but wasn’t open to suggestions and/or I don’t expect any follow through;
- (4) Exhibited behaviors that signaled engagement, yet I am uncertain about their level of follow through; and
- (5) Exceeded expectations for engagement and I have high confidence they will follow through.
Press Factor (1 Item)
Primary *Dependent Variable 1*

I Was Pressed to Talk about Mathematical Reasoning

- **Cycle 1**
- **Cycle 2**
- **Cycle 3**

$\text{ES} = \frac{.20}{1.25} = .16$
Prescriptive Factor (1 Item)
Primary Dependent Variable 2

I Could Articulate my Coach's Theory of Teaching and Learning

Cycle 1

Cycle 2

Cycle 3

ES = .30/.69 = .43

1 1.5 2 2.5 3 3.5 4 4.5 5

Strongly Disagree

Strongly Agree
Primary Analytic Questions

• Are teacher reports of their coaching interactions changing over the course of the year?
  • Press
  • Prescriptive

• Are coaches initial judgments of teacher responsiveness a predictor of status and change for teacher judgments about coaching interactions?
Coaches adjust practice based on teacher responsiveness

Table 1: Effects of Coach Judgments on Partner Teacher Perceptions of Change in Interactions Over 1 Year of Coaching

<table>
<thead>
<tr>
<th></th>
<th>At First Cycle</th>
<th></th>
<th>Growth Slope</th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>s.e.</td>
<td>Coeff.</td>
<td>s.e.</td>
<td>Coeff.</td>
</tr>
<tr>
<td>Average ($\beta_{100}; \beta_{200}$)</td>
<td>.02</td>
<td>.19</td>
<td>.02</td>
<td>.20</td>
<td>-.09</td>
</tr>
<tr>
<td>Tch. Resp. ($\beta_{101}; \beta_{201}$)</td>
<td>-.06</td>
<td>.27</td>
<td>-.06</td>
<td>.28</td>
<td>.34 *</td>
</tr>
<tr>
<td>PC Effcny ($\beta_{102}; \beta_{202}$)</td>
<td>.14</td>
<td>.54</td>
<td></td>
<td></td>
<td>-.84 *</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average ($\beta_{110}; \beta_{210}$)</td>
<td>-.04</td>
<td>.21</td>
<td>-.06</td>
<td>.18</td>
<td>.10</td>
</tr>
<tr>
<td>Tch. Resp. ($\beta_{111}; \beta_{211}$)</td>
<td>.48 ~</td>
<td>.28</td>
<td>.48 ~</td>
<td>.28</td>
<td>-.56 *</td>
</tr>
<tr>
<td>PC Effcny ($\beta_{112}; \beta_{212}$)</td>
<td>-.54</td>
<td>.59</td>
<td></td>
<td></td>
<td>1.14 *</td>
</tr>
</tbody>
</table>

| Task Length          | Coeff.         | s.e.                | Coeff.       | s.e.                 | Coeff.              |
| (As Implemented)     | .01 *          | .00                 | .01 *        | .00                  | .00                 |

* Coaches’ reports of the likelihood teacher follows through on the reported interaction in coach tracker during all reported interactions during the first cycle.

** Efficiency of the pre-conference rigor score. The sum of items on the pre-conference rubric divided by the length of time in pre-conference. More efficient ratings tended to be short pre-conferences.
Overcoming Contextual Challenges with PDSAs

ADAPTIVE INTEGRATION IN ACTION
Coaches work is shaped by different contextual conditions

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<th>Coaches</th>
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<td>Helping teacher prep for state assessments detracts from time spent coaching</td>
<td>25</td>
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<td>District responsibilities detract from time spent coaching</td>
<td>23</td>
</tr>
<tr>
<td>Administrative duties detract from time spent coaching</td>
<td>16</td>
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<td>Reported feeling of being unsupported by principal or conflict between principal’s vision of math instruction and coach’s vision of math instruction.</td>
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<td>Coaching in more than 3 schools</td>
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Coaches work is shaped by different contextual conditions

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“The goals were different. My principal’s goal is we need to make our growth [on state achievement tests], and my coach’s goal for me was to deepen my understanding in mathematics content and work on teaching in that Common Core style.”
Plan, Do, Study, Act (PDSAs)

- A method for improving work processes (e.g., coaching)
- Rapid cycles aimed at learning from practice
- A way to test new coaching strategies on a small scale (e.g., by one coach) to learn what works under different conditions
PDSAs in our coaching work

- Expand use of PDSA routine to learn more about coaching under different conditions
- Experiment with ways to overcome challenging conditions while preserving the integrity of the core coaching practices

Core Coaching Practices
- Deep and specific conversations about the instructional triangle
- Setting mathematical goals
- Providing evidence-based feedback
Implications

• Generating large-scale change with limited resources will require the expert judgments of on-the-ground professionals
• Innovative practices must be adapted to local conditions in order to be implemented beyond sites that resemble initial development sites
• Improvement requires building a measurement system with the potential to:
  • Surface important relationships that would help build theories of teaching development within specific contexts
  • Help coaches (and teachers) monitor different aspects of their teaching as they work toward improvements in teaching together