Developing Coaches – Developing Teachers: Making Mathematics Accessible and Equitable

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National Council of Teachers of Mathematics
Denver, CO
October 8, 2010

Research Partners

Funding By The National Science Foundation
Discovery Research K-12 Program (DR K-12),
Award No. 0918326
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Funded under NSF Award No. 0918326. Any opinions expressed herein are those of the authors and do not necessarily represent the views of the National Science Foundation.
Session Outline

- Examining Mathematics Coaching (EMC) Project Description and Current Coaching Practices
- Research design to examine mathematics coaching
- Professional Development Topics
Session Outline

- Defining coaching knowledge
- Instruments to measure coaching effectiveness
- Becoming Consumers of Coaching
- Tools and Strategies to Maximize Coaching Effectiveness
EMC
Project Description

- EMC is a 5-year research and development project examining the effects of a coach’s “knowledge for coaching” on a diverse population of K-8 teachers.

- It addresses the DR K-12 challenge: 
  *How can the ability of teachers to provide Science, Technology, Engineering, and Mathematics (STEM) education be enhanced?*
Mathematics Coaching

Mathematics classroom coaching is gaining popularity as a school-based effort to increase teacher effectiveness and student achievement.
Mathematics Coaching Defined

“A mathematics coach is an on-site professional developer who enhances teacher quality through collaboration focusing on research-based, reform-based, and standards-based instructional strategies and mathematics content that includes the why, what, and how of teaching mathematics.”
The Examining Mathematics Coaching project (EMC)

- Investigating knowledge that contributes to successful coaching in two domains
  - Coaching Knowledge
  - Mathematics Content Knowledge

- The influence of these knowledge domains is examined in two ways:
  - investigating correlations between assessments of coach and teacher knowledge and practice in each domain
  - by investigating causal effects of targeted professional development for coaches
Knowledge Domains

- Mathematics Content Knowledge
- Knowledge of Teacher Learning
- Knowledge of Student Learning
- Coaching Knowledge
Why Study Coaching?

- Coaching is a promising model for enhancing K-8 mathematics teachers’ abilities to provide quality mathematics education.

- Coaching can be implemented at any point in a teacher’s career (as opposed to mentoring).
Why Study Coaching?

The National Mathematics Panel (2008) reports that schools across the nation are using mathematics specialists, including mathematics coaches, yet there is **limited research proving what makes coaching effective.**
Why Study Coaching?

- There is limited understanding of coaching effectiveness, especially in mathematics.

- Moreover, no studies have demonstrated what types and depths of knowledge effective coaches hold.

- At the same time, implementing coaching involves considerable cost and logistical effort for schools and districts.
EMC Goals

- Coaching knowledge contributes to coaching effectiveness.

- Mathematics content knowledge contributes to coaching effectiveness.

- Contribute to research on knowledge for coaching
  - impacts of coaching knowledge and mathematics content knowledge on teachers’ knowledge, attitudes, and classroom practices.
EMC Research Hypothesis

- Effectiveness is linked to several domains of knowledge.
- Coaching knowledge and mathematics content knowledge contribute significantly to a coach’s effectiveness.
- Effectiveness is measured by the positive impact on teacher practice, attitudes, and beliefs.
Research Questions

- To what extent does the depth of a coach’s knowledge in two primary domains (coaching knowledge and mathematics content knowledge) influence his or her coaching effectiveness?

- To what extent does professional development for coaches in these two areas improve their coaching effectiveness?

- To what extent are the effects of targeted professional development on coaching effectiveness explained by increases in coaching knowledge and mathematics content knowledge?
Research Design

A non-experimental design will answer:

To what extent does a coach’s depth of content knowledge in coaching knowledge and mathematics content knowledge influence coaching effectiveness?
Research Design

An experimental design randomly assigns coaches to one of two groups to answer:

To what extent does professional development targeting these two knowledge domains improve coaching effectiveness?

To what extent are the effects of the targeted professional development explained by increases in knowledge?
## Research Design

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-10</td>
<td>Provide orientation to EMC coaching model.</td>
<td>Web-based PD School Year 2010-11</td>
</tr>
<tr>
<td>Year 2</td>
<td>Provide PD on Mathematics Content Knowledge.</td>
<td>Provide PD on Coaching Knowledge.</td>
</tr>
<tr>
<td>2010-11</td>
<td>Summer 2010 Web-based PD School Year</td>
<td>Summer 2011 Web-based PD School Year</td>
</tr>
<tr>
<td>Year 3</td>
<td>Web-based PD School Year 2011-12</td>
<td>Provide PD on Coaching Knowledge.</td>
</tr>
<tr>
<td>2011-12</td>
<td>Web-based PD School Year 2011-12</td>
<td>Summer 2011 Web-based PD School Year</td>
</tr>
<tr>
<td>Year 4</td>
<td>Provide PD on Coaching Knowledge.</td>
<td>Web-based PD School year 2012-13</td>
</tr>
<tr>
<td>2012-13</td>
<td>Summer 2012 Web-based PD School Year</td>
<td></td>
</tr>
<tr>
<td>Year 5</td>
<td>Web-based PD School Year 2013-14</td>
<td>Provide PD on Mathematics Content Knowledge.</td>
</tr>
<tr>
<td>2013-14</td>
<td></td>
<td>Summer 2013 Web-based PD School Year</td>
</tr>
</tbody>
</table>
## Mathematics Content Professional Development Topics

|---------------------|--------------------|--------------------------|------------------------------------------|-------------------------------|
| - Types and uses of numbers  
- Set/subset and part/whole relationships  
- Number displays and relationships  
- Counting | - Methods and contexts for addition and subtraction  
- Methods and contexts for multiplication and division  
- Mental arithmetic | - Representations  
- Area model  
- Set model  
- Number line model  
- Computational patterns and properties with fractions | - Representations  
- Computational patterns, misconception, and properties with fractions  
- Applications  
- Ratios/Rates | - Mental methods with fractions, decimals, and percents  
- Proportional Thinking  
- Scale drawings  
- Applications |
## Coaching Professional Development Topics

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>- The coach’s role</td>
<td>- Adult learning</td>
<td>- Content-focused conversations</td>
<td>- Standards-based practices</td>
<td>- Cooperative learning</td>
</tr>
<tr>
<td>- Conference set-up and scheduling</td>
<td>- The teacher development process</td>
<td>- Reflective questioning and active listening</td>
<td>for skill proficiency, concept development, and problem solving</td>
<td>- Formative assessment</td>
</tr>
<tr>
<td>- Making relational connections</td>
<td>- Creating a partnership mindset</td>
<td>- Observing and modeling instruction</td>
<td>- Mathematical processes</td>
<td>- Classroom discourse strategies</td>
</tr>
<tr>
<td>- Goal-setting with teachers</td>
<td>- Keys to effective professional development</td>
<td>- Providing feedback</td>
<td>- Activity/inquiry-based instruction</td>
<td>- Nonlinguistic representations</td>
</tr>
<tr>
<td>- Building support from administrators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## EMC Coaching Model

| Coaching Model | • **Pre-conference** of at least 15 minutes focused on planning for upcoming lesson with emphasis on teacher’s stated goals, objectives, and needs  
|               | • **Observation** or model of a lesson  
|               | • **Post-conference** of at least 30 minutes reflecting on planned teacher actions  
|               | Coaching will focus on aspects of standards-based teaching as defined by NCTM process and content standards, not on generic pedagogy such as classroom management |
| Content Focus | Number and Operation; ratio and proportion |
| Frequency     | Three teachers per coach provide data points for research. Teachers are coached at least 8 times per academic year and at least four times within the content focus |
| Quality Assurances | Coach and teacher reflection instruments, coach skill inventory, and teacher needs inventory ensure consistent implementation of coaching across schools  
|                 | Self-identified teacher needs are used in planning and goal setting, and progress toward these goals is monitored and reflected on by coaches |
Delphi Study

- An iterative process where experts identify and refine the constructs being studied

- Three phase process:
  - *Phase I*: Identification – Identify knowledge areas;
  - *Phase II*: Definition – Define knowledge areas; and
  - *Phase III*: Validation – Validate the knowledge areas and definitions
Defining Coaching Knowledge

- Three phase process engaged 10 national experts and practitioners in the area of mathematics coaching.
- The Delphi panel identified 8 components of coaching knowledge.
- Experts collectively defined each knowledge area and expressed their level of agreement with the collective definitions.
Coaching Knowledge

- Relationships
- Leadership
- Student Learning
- Assessment
- Teacher Practice
- Teacher Development
- Teacher Learning
Complexity of Coaching

- Coaching is a collaborative process that is done with teachers, not to teachers.

- Coaching is a joint effort from both the coach and the teacher(s) involved.

- Coaching support is useful only if the teacher and coach are prepared, and willing to listen, internalize, and respond accordingly.
Effective Coaching Practice

A coach should:
- Ask reflective questions
- Provide feedback
- Share materials and resources
- Maintain confidentiality
- Use a coaching cycle:
  - Gather information before the lesson
  - Observe a complete lesson
  - Collect and document evidence
  - Debrief and reflect after the lesson
Boundaries of Coaching

A coach generally does not:

- Evaluate teachers
- Take over during a lesson
- Impose specific lessons or instructional strategies
- Tutor struggling students
- Perform the support services of an aide
Becoming Consumers of Coaching

- There is no single recipe for effective coaching.
  - Approaches to coaching vary as widely as do the teachers, coaches, and schools involved.

- Despite variations in coaching, it remains the teacher’s responsibility to become

  a consumer of coaching.
Becoming Consumers of Coaching

A commitment to creating a collaborative and rewarding coaching relationship will help maximize the benefits of coaching.

- Coaches are only as effective as their teachers will allow.
- A wise consumer of coaching makes the most of this educational investment.
Becoming Consumers of Coaching

To maximize the benefits of coaching, a teacher must:

- communicate specific instructional needs;
- be willing to ask for specific types of support;
- be able to listen and hear ideas; and
- take shared responsibility for cultivating a positive and productive coaching relationship.
## What Coaches Expect from Teachers

<table>
<thead>
<tr>
<th>Effective Coaching</th>
<th>Expectations from Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is structured</td>
<td>Set aside time for coaching</td>
</tr>
<tr>
<td>Requires reflection</td>
<td>Share goals and beliefs</td>
</tr>
<tr>
<td>Requires two-way communication</td>
<td>Express needs and expectations</td>
</tr>
</tbody>
</table>
## Effective Coaching Expectations from Teachers

<table>
<thead>
<tr>
<th>Effective Coaching</th>
<th>Expectations from Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is content-based</td>
<td>Focus on improving mathematics teaching and learning</td>
</tr>
<tr>
<td>Is evidence-based</td>
<td>Built on identified elements from sessions and observations</td>
</tr>
</tbody>
</table>
Tools to Support Coaching

The Examining Mathematics Coaching (EMC) project has developed and refined tools to help coaches and teachers in the coaching process.

- Coaching Skills Inventory
- Teacher Needs Inventory
EMC Coaching Skills Inventory

...is intended to measure a coach’s perspective on her or his own level of effectiveness or confidence with various coaching responsibilities.
EMC Coaching Skills Inventory

Areas explored include:

- Coach/Teacher Relationships
- Coaching Skills
- Mathematics Content
- Mathematics-Specific Pedagogy
- General Pedagogy
- Background and practices as an educator
## Coaching Skills Inventory

### I. Coach/Teacher Relationships

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at All Effective</th>
<th>Very Effective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How effective do you feel observing lessons and giving teachers feedback?</td>
<td>0 0 0 0 0</td>
<td>0</td>
</tr>
<tr>
<td>2. How effective do you feel creating environments where teachers reflect openly on their instructional practices?</td>
<td>0 0 0 0 0</td>
<td>0</td>
</tr>
<tr>
<td>3. How effective do you feel helping teachers set goals and objectives aimed at improving their instruction?</td>
<td>0 0 0 0 0</td>
<td>0</td>
</tr>
<tr>
<td>4. How effective do you feel creating an environment of open discussion and constructive criticism with teachers?</td>
<td>0 0 0 0 0</td>
<td>0</td>
</tr>
</tbody>
</table>
Teacher Needs Inventory

...is designed to help the teacher take ownership of the coaching process. The responses are used by the coach as a tool to help focus the coaching and increase effectiveness.
EMC
Teacher Needs Inventory

Areas explored include:

- Teaching Conceptual and Inquiry-Based Lessons
- Classroom Environment
- Conceptual Understanding of Mathematics
- Mathematics Content Knowledge
- Classroom Management
# Teacher Needs Inventory

## IV. Mathematics Content Knowledge

<table>
<thead>
<tr>
<th>Question</th>
<th>Not at all Confident</th>
<th>Very Confident</th>
<th>Regarding this topic, …</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. How confident are you with the mathematics you teach?</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16. How confident are you with the mathematics beyond the mathematics that you teach, meaning the next grade level?</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>17. How confident do you feel planning lessons that include fraction concepts?</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>18. How confident do you feel planning lessons that include number sense and operations?</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Coach and Teacher Reflections

... are tools for monitoring and logging coaching interactions including quantity, quality, and duration of coaching sessions along with measuring coaches and teachers’ perceptions of coaching’s impact on instruction.
Coach and Teacher Reflections

Areas explored include:

- Interactions with the coach and/or teacher
- Frequency of various activities (pre-lesson conference, observation, post-lesson conference, modeling a lesson, etc.)
Coach and Teacher Reflections

- Duration of various activities (pre-lesson conference, observation, and post-lesson conference)
- Coaching Relationship
Coach and Teacher Reflections

- Mathematics Content
- Mathematical Concept and Inquiry
- Classroom Environment/Culture
- Reflection and Planning
- Impact on Teacher Practice
# Coach Reflection & Impact

## Mathematics Content

<table>
<thead>
<tr>
<th></th>
<th>Not at All</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>To a Great Extent</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>The teacher and I discussed significant and worthwhile mathematical content.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>The teacher and I discussed mathematical content at the grade level(s) she/he teaches.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>The teacher and I discussed ways to increase the level of cognitive demand of the mathematical content being taught.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>The teacher and I discussed mathematical content beyond the grade level(s) she/he teaches.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Teacher Reflection & Impact

<table>
<thead>
<tr>
<th>Reflection and Planning</th>
<th>Not at All</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>o. My coach and I set goals and objectives aimed at implementing ideas and addressing</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>issues we discussed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p. My coach and I were reflective about my students’ learning.</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>q. My coach and I were reflective about my teaching practices.</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>
Developing Coaches – Developing Teachers

- Questions
- Insights
- Ideas
- Comments
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