Strengthening Infrastructures for Promoting Equity in Mathematics Education through Research-Practice Partnerships

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Location of Slides

You can find the slides for this presentation here:
Presentation Overview

• The present moment: Scaling and sustaining equitable reforms in a time of virulent nationalism and fragmentation

• The opportunity: Research-practice partnerships that foreground equity

• The infrastructure: The one a partnership can build and one that is needed for partnerships
A Time of Virulent Nationalism

• Story that captures student feelings about the times we are living in (American Educator piece)
• Frustrated, because the notion of education as a civil right for all students is under direct threat
There are existence proofs...
The Challenge of Sustainability

Positive impacts for students at all levels of achievement, for Latino students, for girls and boys

Factors related to sustainability:
• Baseline scores on complex mathematics of students in the prior year
• Perceived coherence of intervention with local goals of schools and districts
• Ratings of the quality of professional development
What We Need

• Infrastructure

• Better infrastructures for
  – Keeping equity at the center
  – Designing collaboratively in ways that include all stakeholder voices
  – Building greater horizontal and vertical coherence in systems
Infrastructures
Educational Infrastructures: An Analogy
Research-Practice Partnerships as Infrastructures
Research-Practice Partnerships as Infrastructures

• Research-Practice Partnerships: A definition
• Lines of work within the Inquiry Hub partnership:
  – Centering equity in analysis of curriculum and student experiences
  – Collaboratively designing curriculum that is coherent and meaningful from the student perspective
  – Building horizontal and vertical coherence through expanding assessment
long-term collaborations between educators and researchers that are organized to investigate problems of practice and solutions for improving systemic outcomes.

http://researchandpractice.org/toolkit
A Continuum of Arrangements

Program hires or assigns researchers to study it.

Educators define the problems to solve and goals of the engagement

Research team approaches program to participate in a study.

Researchers define the problems to solve and goals of the engagement
A Continuum of Arrangements

Educators as client or customer
Researchers as consultants

Program hires or assigns researchers to study it.

Researchers as knowledge builders
Educators as subjects

Research team approaches program to participate in a study.

Educators define the problems to solve and goals of the engagement

Researchers define the problems to solve and goals of the engagement
A Continuum of Arrangements

Program hires or assigns researchers to study it.

Educators define the problems to solve and goals of the engagement

Research Practice Partnership

Research team approaches program to participate in a study.

Researchers define the problems to solve and goals of the engagement
Key Characteristic: RPPs Are Mutualistic

- Commitment to work on projects that benefit all parties
- Negotiate in an ongoing way the focus of joint work
- Promotes view that all perspectives are valued in the search for solutions
Key Characteristic: RPPs Are Mutualistic

- Work we do that we define together.
- Work educators need to do where there’s less direct reward to researchers.
- Work researchers need to do where there’s less direct reward to educators.
Key Characteristic: RPPs Are Focused on Problems of Practice, Sites of Possibility

- Problems of practice: Where practitioners struggle to accomplish goals for promoting equity
- Sites of possibility: Seeds that can become new programs and practices that address problems seen by different stakeholders
- These shape the:
  - Research questions that are asked
  - Innovations that are designed and tested
Anatomy of a Problem in a Project within an Emerging Partnership

Improving the Quality of Assessments Used in Inquiry Science

Earlier study in another city found teachers did not use embedded assessments, and those they used were of low quality.

US curricula embed few resources to support sensemaking.

Increasing Coherence of Supports for Teaching

Commitment to building teacher capacity to implement and assess standards-based curricula that support inquiry.
Anatomy of a Problem in a Project within an Emerging Partnership

Improving the Quality of Assessments Used in Inquiry Science

Support teachers in building a culture of public reasoning and argument

Increasing Coherence of Supports for Teaching
Partnerships Tend to Start Small

- A proposal
- A project
- A consulting activity
CU-DPS Partnership Today

- Building teacher capacity for NGSS
- Computational Thinking Units
- Practical Measurement Study
- Biology Curriculum
- Extended interim Assessment Tasks
Key Characteristic: RPPs Are Long-Term

- Multiple lines of work emerge that are linked to a broader research agenda
- Commitment to continuing to work together becomes more open-ended
Key Characteristic: RPPs Are Intentionally Organized

- Regular check-ins with key partners
- Longer term strategic planning
- Collaborative design processes
- Data agreements
- Governance
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- Governance

*Partnerships are more than just “projects,” they are arrangements that cross traditional organizational boundaries.*
Key Characteristic: RPPs Create Mechanisms to Address Inequity

- Take stock of historical inequities together
- Define “equity” within the partnership
- Structure participation equitably
- Assess equity goals
  - In the partnership
  - In implementation and outcomes
Inquiry Hub Partnership

• A long-term research-practice partnership between researchers at CU Boulder and Denver Public Schools
Math Work: Task Analysis

• *Identifying* tasks that addressed gaps in the existing scope and sequence for the district
  – Significant gaps due to content shifts in CCSS-M

• Rating task qualities as a group
  – Built from approach to professional development developed by Stein, Smith, Henningsen, & Silver (2009)
  – Intended to support shifts in rigor called for in CCSS-M
Teacher Involvement

- Rating the qualities of tasks as a group (adapted from the Stein and colleagues approach)
- Identifying topics for which there were not adequate opportunities to learn presented in the district-adopted textbook (new: fitting to district context)
- Developed and iterated on two rubrics that included dimensions specifically related to equity of opportunity for English Language Learners (new)
Language Rubrics

• Created to address learning needs of emerging bilinguals
• Focus on both the need to engage in rich mathematical discourse and gain access to tasks
• Two rubrics:
  – Language options for expression (opportunities
  – Task language
Rating Schemes and Discussion

Language: Options for Expression

<table>
<thead>
<tr>
<th>Level</th>
<th>Number of Raters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explicit and Highly Varied</td>
<td>1</td>
</tr>
<tr>
<td>Explicit and Somewhat Varied</td>
<td>1</td>
</tr>
<tr>
<td>Implicit and Limited</td>
<td>2</td>
</tr>
</tbody>
</table>

What evidence from the task supports your rating?
What language from the rubric for options for expression supports your rating?
Infrastructural Components

• Ratings platforms (technological infrastructure)
  – Prototype for task rating
  – Curriculum Customization Service with tasks and ratings of tasks

• Rubrics (representational infrastructure)
  – Focus on dimensions relevant to equitable participation
  – Dimensions held tensions rather than dismissed them
  – Holding fast to cognitive demand independent of teachers’ judgments
Co-Design: A Definition

“A highly-facilitated, team-based process in which teachers, researchers, and developers work together in defined roles to design an educational innovation, realize the design in one or more prototypes, and evaluate each prototype’s significance for addressing a concrete educational need.”

Penuel, Roschelle, & Shechtman, 2007, p. 51
Target of Co-Design

• Project-based science units that are:
  – Anchored in investigations of *phenomena*
  – Engage students in *solving problems* that arise from investigations of phenomena

• Desired Qualities
  – Address a “bundle” of performance expectations from the Next Generation Science Standards
  – Have strong intra-unit coherence
  – Students experience as personally relevant
  – Are deeply digital
Defining a Design Challenge

- Positions students as designers of a solution to a problem that arises from the anchoring phenomenon
- Connects students in a meaningful way to the community
Design Challenges

Choosing a Tree to Plant

Infographic for Health Clinic

Organize a Café Scientifique
Building a Storyline

We build *storylines* that anticipate sequences of student questions that can drive learning forward.
### Why Don’t Antibiotics Work Like They Used To? (Bend 1 - Bacteria)

This Lesson...What we are doing now: This is the first lesson in the series. Up until this moment, students may never have considered why antibiotics today don’t work as well as they used to. In this lesson you will draw upon their experiences with antibiotics and introduce an anchoring event (Addie’s case) to which you’ll refer throughout the unit. Students will analyze a front line video about a pan-resistant bacterial infection case in a little girl, named Addie. Students will ask questions regarding why aren’t the antibiotics helping Addie get better. You’ll guide them to decide to start a fact timeline with what happened to Addie in chronological order and separate out the differences between species of bacteria “kinds” and strains “types” with each kind.

<table>
<thead>
<tr>
<th>Lesson Question</th>
<th>Phenomena</th>
<th>Lesson Performance Expectation(s)</th>
<th>What We Figure Out  (CCC's &amp; DCIs), New Questions and Next Steps</th>
</tr>
</thead>
</table>
| L1: How did this little girl (Addie) get so sick? (1 period)                   | A Frontline video clip introduces us to the case of a little girl (Addie) who came into the hospital with a bacterial infection. After several weeks of antibiotic treatment she ends up with life threatening pan-resistant bacteria: | Ask questions that arise from careful observation of unexpected results, to clarify and seek additional information about how bacteria caused this little girl (Addie) to become and stay so sick despite receiving antibiotics. | We have lots of experiences related to bacterial infections and taking antibiotics. For example, some of us have had to take antibiotics from a doctor, some of us have taken other family member's antibiotics. We know family members who had to take antibiotics because they had pneumonia, while others took antibiotics due to a minor infection from a cut.

We noticed some important patterns in Addie's case and organized these events into a timeline:
- Addie was cut while playing on the playground in 2011.
- She came to the hospital sick from an infection caused by one type of bacteria from this cut.
- Doctors gave her an antibiotic that worked for awhile, but then stopped working.
- She ended up getting another infection from a different type of bacteria while in the hospital.
- Doctors then gave her a new antibiotic that worked for awhile, but then it stopped being effective and Addie got sicker. They tried a third antibiotic and Addie started to improve but this antibiotic also stopped being effective and she got worse once again.
- They repeated this process trying every antibiotic available to them.

We identified some important differences in bacteria that the doctors refer to:
- Addie had a type of bacteria in her lungs that was not the type they expected (pan-resistant).
- Pan drug-resistant bacteria have "armor" that the antibiotic can't penetrate.
- There are different types of bacteria, resistant vs. susceptible (non-resistant).
- And there are different kinds of bacteria: Staph (Staphylococcus) and Stenotrophomonas.

We decided it was important to pay attention to the different types and kinds of bacteria and kept track of this information in a summary chart. She seems to have had infections from two different "kinds" of bacteria: (a) Staphylococcus and (b) Stenotrophomonas. Some of both kinds of bacteria appear to have been killed by antibiotics. However, some of both kinds of bacteria were not killed by those antibiotics. It appears that there are two types of bacteria within each kind of bacteria—those that were resistant to one antibiotic (and lived) and those were not resistant to an antibiotic (and died).

We have a ton of questions! Why is that happening? Can this happen to me? From where can you get bacteria? How can a substance that helps wipe out the bacteria work for a bit, then stop working? How do antibiotics even work?

After making a record of our questions, we identify some next steps to pursue. Because we are really concerned about whether this can happen to us, we want to know if cases like Addie's are common, or if this is a pretty isolated case.
Measures of Student Experience

Percent of Students Saying Lesson "Matters to Me"

Teacher 14: 48%
Teacher 13: 62%
Teacher 12: 56%
Teacher 11: 59%
Teacher 10: 59%
Teacher 9: 58%
Teacher 8: 52%
Teacher 7: 49%
Teacher 6: 68%
Teacher 5: 63%
Teacher 4: 35%
Teacher 3: 63%
Teacher 2: 39%
Teacher 1: 61%
Infrastructural Components

• A highly facilitated co-design process
  – Storyline as a tool for promoting coherence from student perspective
  – Includes opportunities for teachers to shape the process and the content
  – Student voice: Selecting an anchor for units in project is informed by a student interest survey

• A simple, Google Forms-based mechanism for monitoring equity in student experience within and across classrooms
Infrastructural Components (Planning Stages)

• New interface for our student-facing measures to support teacher customization and analysis of data
• Extending partnership to include a youth organization:
  – To expand youth voice in selection of engineering design challenges
  – To support teachers in developing more attention to developing constructive relationships with students
Promoting Coherence

• For teachers, it is not enough to build a new curriculum or program that addresses standards.
  – They need professional development aligned to goals of curriculum.
  – Assessments used by the district need to focus on goals of the curriculum.

• An RPP must engage in work to identify parts of the instructional guidance infrastructure to re-design and work to enhance vertical and horizontal coherence.
Building a Coherent and Equitable System in Denver Public Schools

New, phenomenon-based biology units embed assessments to elicit interests, related experiences, and 3D learning performances.
Building a Coherent and Equitable System in Denver Public Schools

**SLO Rubrics:** Analyzing Growth in Modeling Practice

**Principal Observation Protocol:** What are you figuring out today?

**Professional Development Supports:** Analyzing and Grading Student Work, Using Exit Ticket Data

Re-designed infrastructure components aim to provide consistent guidance to teachers.

3D Transfer Tasks
Infrastructural Components

• New interim assessments and process for developing them
  – New grant: Focused on building cadre of assessment developers using a set of tools and PD the CU team has developed collaboratively with input from district and state leaders across the US

• Walkthrough protocol

• Classroom assessments that can be graded in ways that meet teachers’ expectations and those of their principals
The Challenges to the Work

• Synchrony
• Evidence gathering and use
• Resources for addressing emergent needs
• Finding time to share and learn from other partnerships
• Concerns about interest convergence (Bell)
The Infrastructure Partnerships Need

• Funding for more than just innovation…but infrastructure for partnerships and addressing emergent needs

• Networks for sharing across partnerships

• Educational change in:
  – Preparation of doctoral students in both research and education leadership
  – Incentives in the academy
What’s New

• Possibilities for learning from partnership work
• Recognition of the multidimensionality of challenges related to equity
• The larger sociopolitical context