Improving Inservice Teacher Education with Design-Based Implementation Research

William R. Penuel

University of Colorado Boulder
Contemporary reforms with “ambitious” aims present dilemmas to teachers that are at once new and familiar:

• They demand new forms of expertise of teachers, but that expertise is not sufficient to guide teaching of diverse students, whose interest and commitment are necessary to meet those aims.

• The more they seek higher standards for students, the more they are likely to lead to student resistance, failure, or both. (Cohen, 2011).
In science education...

- Districts and states are moving forward with reforms linked to the vision of the *Framework for K-12 Science Education*

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A Framework for K-12 Science Education
Practices, Crosscutting Concepts, and Core Ideas

PRACTICES
CONTENT
CROSSCUTTING
In science education...

Meanwhile, in school districts:

- Some teachers are being asked to address two sets of standards
- Pacing guides, interim assessments, and state assessment systems do not yet align with the vision of the Framework
- Teachers are left to do sensemaking to reconcile conflicting guidance on their own and with limited support (Allen & Penuel, in press, *JTE*).
And in the research community...

• Much of our research remains focused on:
  – Studying student learning within a single program or setting
  – Professional development as a means to develop teachers’ content knowledge and pedagogical content knowledge

• When we do talk about scale, we usually mean scale-up research that tests the efficacy or effectiveness of particular professional development programs.
A Family of Approaches

…for relating research to practice
…for developing evidence related to innovations
…for bringing innovations to scale

THE CARNEGIE FOUNDATION
for the ADVANCEMENT of TEACHING

“improvement science”

SERP
Strategic Education Research Partnership

“problem-solving research, development, and implementation”

MIST
MIDDLE SCHOOL MATHEMATICS AND
THE INSTITUTIONAL SETTING OF TEACHING

“designing for improvement at scale”
Four Principles of DBIR

1. Teams form around a focus on persistent problems of practice from multiple stakeholders’ perspectives.
2. To improve practice, teams commit to iterative, collaborative design.
3. To promote quality in the research and development process, teams develop theory related to both classroom learning and implementation through systematic inquiry.
4. Design-based implementation research is concerned with developing capacity for sustaining change in systems.
What is iHub?

• A project funded by the National Science Foundation and the Moore Foundation.
  – To design and study digital curriculum materials that can help teachers implement new standards.
What is iHub?

• A long-term partnership of Denver Public Schools, UCAR, CU Boulder, and BSCS
  
  – We work on district challenges together, applying what we know from research to develop solutions collaboratively.
How We Decide Focus of Joint Work

Teams form around a focus on persistent problems of practice from multiple stakeholders’ perspectives.

• Proposal stage:
  – District: Need for a “deeply digital” curriculum that is open access and student-centered
  – BSCS: Desire to update *Green* version of ninth grade biology curriculum
  – CU/UCAR: Desire to continue research and development on a digital platform, the Curriculum and Customization Service
How We Decide Focus of Joint Work

Teams form around a focus on persistent problems of practice from multiple stakeholders’ perspectives.

• We periodically re-negotiate the focus of joint work through:
  – Weekly meetings
  – Semi-annual half-day retreats between university researchers and district leaders
Organizing Collaborative Design

To improve practice, teams commit to iterative, collaborative design.

- Our partnership is *multi-tiered* (Severance, Leary, and Johnson)
  - Leadership: District leaders and researchers
  - Research: Researchers, curriculum developers, software developers
  - Design team: Everyone
## Organization of Initial Workshop

<table>
<thead>
<tr>
<th></th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Monday</th>
<th>Tuesday</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Morning</strong></td>
<td>Learning about the Framework</td>
<td>Brainstorming Phenomena</td>
<td>Revisiting unit structure</td>
<td>Revisiting unit structure</td>
<td>Lesson design in small groups</td>
</tr>
<tr>
<td></td>
<td>Unpacking HS-LS2</td>
<td>Developing initial unit structure</td>
<td>Reviewing relevant resources</td>
<td>Reviewing relevant resources</td>
<td></td>
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<tr>
<td><strong>Afternoon</strong></td>
<td>Developing a web of concepts</td>
<td>Identifying three-dimensional assessment tasks</td>
<td>Lesson design in small groups</td>
<td>Lesson design in small groups</td>
<td>Planning for ongoing work and for unit enactment</td>
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</tbody>
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Structured Learning Time about *Framework* and NGSS

Structured Feedback Related to Coherence
<table>
<thead>
<tr>
<th>Student Phase of Investigation Cycle/&quot;Cascade of Practices&quot;</th>
<th>Lesson Number</th>
<th>Driving Question</th>
<th>What Students Will Figure Out</th>
<th>(What Students DO/Science and Engineering Practice)</th>
<th>What the Phenomenon Is</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define Overarching Unit Question</td>
<td>1.1</td>
<td>Why should we care about trees?</td>
<td>Things that they know already and need to figure out to solve the challenge; Benefits of trees to people that are a priority to the class that they want to maximize to solve the challenge</td>
<td>Students ask questions related to the possible impacts of planting trees to modify the environment; Students further define the engineering problem by identifying reasons why they care about trees and relate them to the challenge.</td>
<td>Cities are ecosystems where human activity is constantly modifying the environment, such as through building and construction, redirecting waterways, and consumption of energy for cars, heating, and cooling.</td>
</tr>
<tr>
<td>Define Question/Problem</td>
<td>1.2</td>
<td>What effect do trees have on the air temperature around us?</td>
<td>Cities are much hotter than surrounding areas, and the pattern on maps shown at the regional and neighborhood scale shows that where there are more buildings, it's hotter, while where there are more trees, the temperature is cooler.</td>
<td>Students analyze data from graphs and maps to identify land cover patterns associated with the Urban Heat Island effect.</td>
<td>THE &quot;URBAN HEAT ISLAND&quot; PATTERNS OF HEAT/COOL ARE OBSERVABLE AT NEIGHBORHOOD AND REGIONAL LEVEL LEVEL</td>
</tr>
<tr>
<td>Plan and Carry Out Investigation</td>
<td>1.3</td>
<td>Why is it cooler where there are trees than where there are buildings and roads?</td>
<td>Trees cool the air in part by reducing the amount of sunlight striking buildings and pavement, which reduces the amount of energy that is absorbed and re-radiated into the air.</td>
<td>Students plan and carry out an investigation of effects of different surfaces on temperature in the classroom.</td>
<td></td>
</tr>
<tr>
<td>Analyze Data</td>
<td>1.3</td>
<td>How does water from trees help cool the air?</td>
<td>Trees can cool the air through the process of evapotranspiration</td>
<td>Students plan and carry out an investigation of effects of evapotranspiration.</td>
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Iterative Design Process

Spring 2014

**Assembling Team**
Researchers, Teachers, Scientists, Community Members

Summer 2014

**Initial Workshop**
Developing understanding of NGSS and building a coherent unit structure

Fall 2014

**Lesson Plan Development**
Team-based development of lessons with routine virtual and face-to-face whole group check-ins

Summer 2015, 2016

**Major Revision**
CU-UCAR Team makes revisions based on pilot

Feb-March 2015

**Small Revision**
Teams revise and develop needed teacher supports, including PD

April-May 2015

**Pilot Test**
Teachers pilot unit and researchers study implementation and student learning

April-May 2016

**Expert Review**
Scientists, teachers, educational leaders, and researchers review using EQuIP criteria

January 2015

Summer 2016

**Publish To CCS**
Developing Evidence to Inform Design

Teams develop theory related to both classroom learning and implementation through systematic inquiry.

<table>
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<tr>
<th>Research Question</th>
<th>Sources of Evidence</th>
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| How do teachers in the collaborative design process engage with the ideas in the  | Field notes of collaborative design process  
| Framework for K-12 Science Education?                                             | Informal interviews  
|                                                                                  | Surveys of teachers’ experience of the design process and recommendations for  
|                                                                                  | improvement                                                                |
| How well do the materials teachers design reflect the vision and principles of the | External reviews using a rubric (adapted from Achieve’s EQUiP rubric)             |
| Framework?                                                                        |                                                                                     |
| How do teachers’ adapt the materials as they implement them?                      | Post-enactment reflections  
|                                                                                  | Observations                                                                       |
| How does student learning in design teachers’ classroom compare to student learning in similar classrooms? | Extended tasks designed for the district’s interim assessments |
Theories of Implementation

• Sensemaking theory (Weick, 1995)
  – Focuses on how local actors (e.g., teachers) go about making sense of uncertainty and confusion from conflicting messages in their organizational environment

• How it has informed design
  – Inclusion of specific activities to surface conflicting messages teachers experience periodically throughout design with district leaders present
Building Capacity

Design-based implementation research is concerned with developing capacity for sustaining change in systems.

• Focus is on capacity of the partnership to get better at improvement (following the idea of a networked improvement community)

• At present, we are focused mainly on:
  – Using what we learn from perspectives on design to improve efficiency of materials development
Building Capacity for DBIR

• Graduate education
  – Within educational leadership programs
  – Within teacher education programs
  – Within learning sciences programs

• Building practical “tools of the trade” for research-practice partnerships
  – Organizing collaborative design
  – Developing and using implementation evidence
Thank You

Contact:
william.penuel@colorado.edu

On the web:
http://learndbir.org
http://researchandpractice.org

On Twitter:
@LearnDBIR @bpenuel

DBIR Summer Workshop
Boulder, CO
July 16-18, 2015
To register:
http://learndbir.org/workshop

In print: