Preparing Mathematics Teachers to Facilitate the Problem-Solving Cycle Professional Development

Hilda Borko

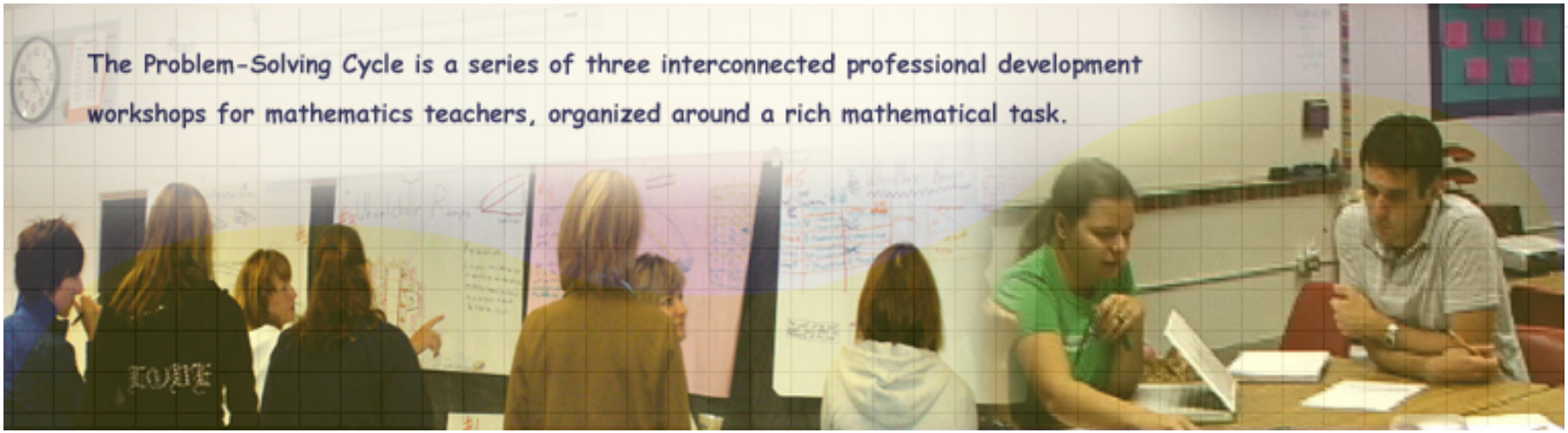
Symposium and Workshop on Video Resources for Mathematics Teacher Development
Weizmann Institute, June 2016

CSET center to support excellence in teaching

Stanford University

PSC

Problem Solving Cycle



Teacher Professional Development and the Role of the PD Leader: The Problem-Solving Cycle Research Program

Hilda Borko
Jennifer Jacobs
Karen Koellner

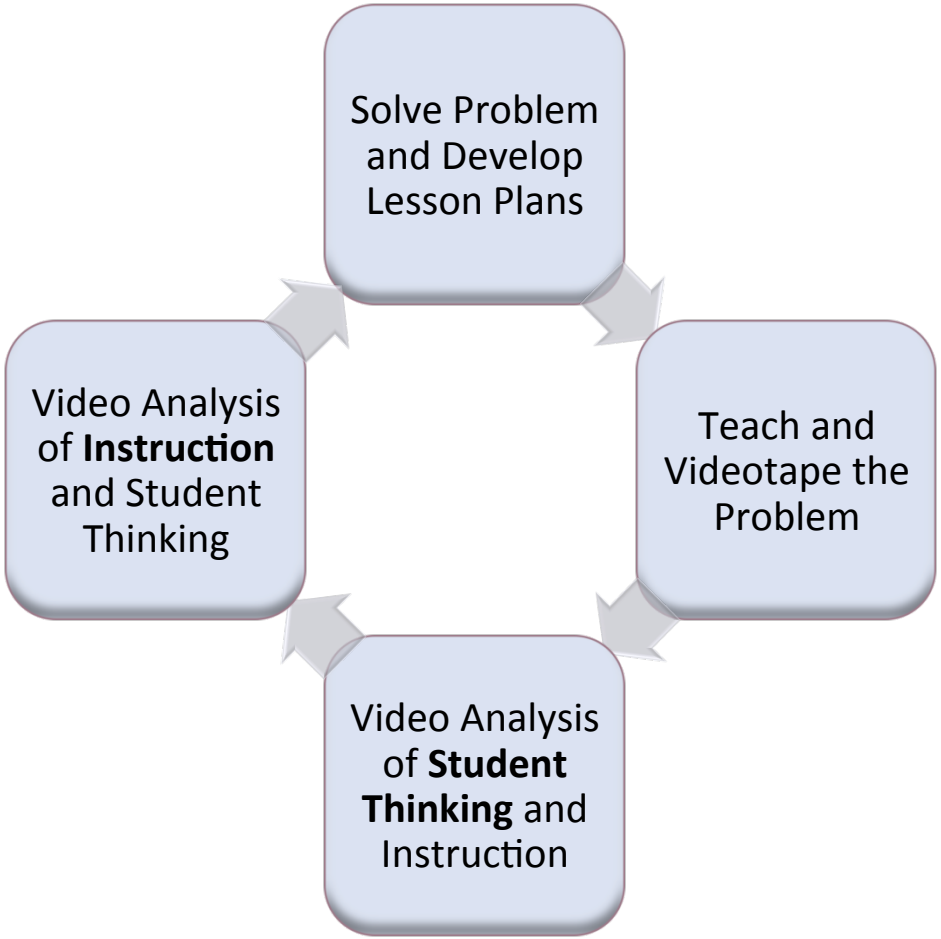
And many PhD students from the University of Colorado, Hunter College & Stanford University

University of Colorado at Boulder School of EDUCATION

HUNTER The City University of New York

Stanford GRADUATE SCHOOL OF EDUCATION

The Problem-Solving Cycle



Workshop 1 and the PSC Lesson

Workshop 1

- Teachers work collaboratively to solve a task & develop plans
- The emphasis is on:
  - multiple representations and solution strategies
  - advantages and disadvantages of each
  - mathematical relationships among them

The PSC Lesson

- Each teacher conducts a lesson with the problem in one of her/his classes
- Lessons are videotaped

Workshops 2 & 3: Video Analysis

[PICTURE REMOVED]

Students engaged in small group work

Teachers analyze student thinking

Video-Based Discussions: An Example

- Power of video in professional development
  - Brings the classroom into the PD
  - Opportunity to collaboratively study practice
  - Guide analysis of teaching and learning
- Power of video in research on Teaching and Learning
  - Record of interactions an observer might not notice
  - Investigate multiple research questions
  - Using multiple analytic techniques

Pattern Task

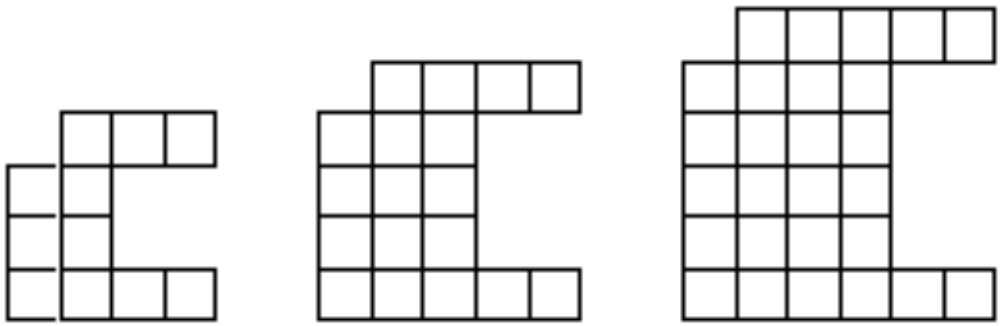


Figure 1 Figure 2 Figure 3

- Find the number of tiles in each figure.
- Show and explain how the pattern grows.
- Generalize the pattern by writing a rule

Group Work with the Pattern Task

[PICTURE AND VIDEO REMOVED]

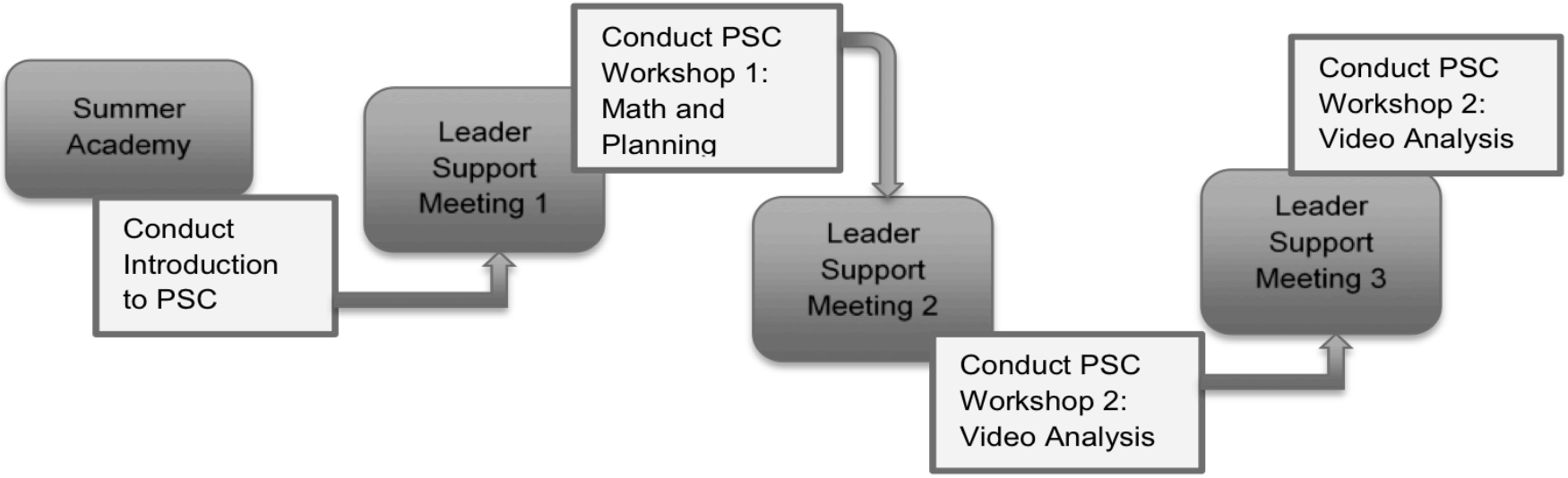
What does the teacher say and do to support students' mathematical problem solving?

Summary of PSC Principles

Several principles underlie the Problem Solving Cycle framework

- Provides a common teaching experience
- Situated in teachers' instruction through artifacts of practice (e.g., video clips)
- Central role of community in determining how and what people learn
- Long term and ongoing
- Adaptive to participants' needs and priorities

Mathematics Leadership Preparation Model



Implementing the Problem-Solving Cycle: Project Design

- One school district
  - Volunteer schools and participants
  - 1-2 Instructional Leaders per school
- Our intervention
  - Summer Leadership Academy 08 & 09
  - Two PSC cycles AY 08-09; Two cycles AY 09-10

Research Questions: Impact on Teachers and Students

Teachers' Knowledge	What is the impact of the iPSC on the participants' mathematical knowledge for teaching?
Classroom Instruction	What is the impact of the iPSC on the participants' teaching practices?
Student Achievement	What is the impact of the iPSC on student achievement?

Impact Results Summary

- Participation in the iPSC supported modest improvements in:
  - Mathematical knowledge for teaching
  - Classroom instruction
- Largest instructional changes in:
  - Working with students
    - Attribute to emphasis the PSC places on understanding students' mathematical thinking
- Student achievement data cautiously encouraging
  - Caveat: changes in participating schools, teachers, and students

Initial Analysis of PD Implementation

- Research Questions
  - To what extent did the teacher leaders enact the PSC with integrity to its key features?
  - Which features of the PSC did the TLs enact particularly well?
  - Which features were the most problematic to enact?
- Analysis
  - Rated all PSC workshops using adapted version of Professional Development Observation Protocol (PDOP)

Pedagogical Content Knowledge

To what extent do the TLs use strategies designed to deepen teachers' knowledge of content and students, and knowledge of content and teaching?

Indicator	
1 Video clips are accessible and relevant to the teachers.	Video Clips
2 Video clips are appropriate with respect to the level of trust within the community	
3 Questions about video encourage teachers to think deep thinking about students' mathematical reasoning	Student Reasoning
4 TL frames discussions and use prompts to foster development of KCS	
5 Teachers engage in careful unpacking and deep analysis of students' mathematical reasoning	
6 Questions about video encourage teachers to think deeply about instructional practices	Instructional Practices
7 TL frames discussions and uses prompts to foster development of KCT	
8 Teachers engage in careful unpacking and deep analysis of instructional practices	

Pedagogical Content Knowledge : Teacher Leaders' Perspectives

I just think that after doing my first video workshop I felt more comfortable and I was more prepared with the different types of questions and things to ask them to keep the focus moving in the right direction.

- Mandy

I think I should have sat down and thought of some better questions to ask. I had some, but in retrospect, after I replayed it in my own mind, I came up with about four more that I could have asked about different things.

- Jordan

The CSET/Urban Unified School District Researcher-Practitioner Partnership

- Project Goals
  - Develop and test a large-scale, system-level PD program aligned with the Common Core State Standards - Mathematics
  - Build capacity in UUSD to conduct site-based PD
  - Refine theories of teacher and leader learning
- The Starting Point
  - UUSD's new task-based mathematics Core Curriculum
  - CSET's Problem-Solving Cycle (PSC) and Mathematics Leadership Preparation (MLP) models

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Adapting the Problem-Solving Cycle and Leadership Models with a School District

Stanford Team

- Hilda Borko (PI)
- Janet Carlson (Co-PI)
- Charmaine Mangram (Post-Doc)
- Robin Anderson
- Alissa Fong
- Susan Million
- Suki Mozenter
- Anthony Muro Villa

UUSD Personnel

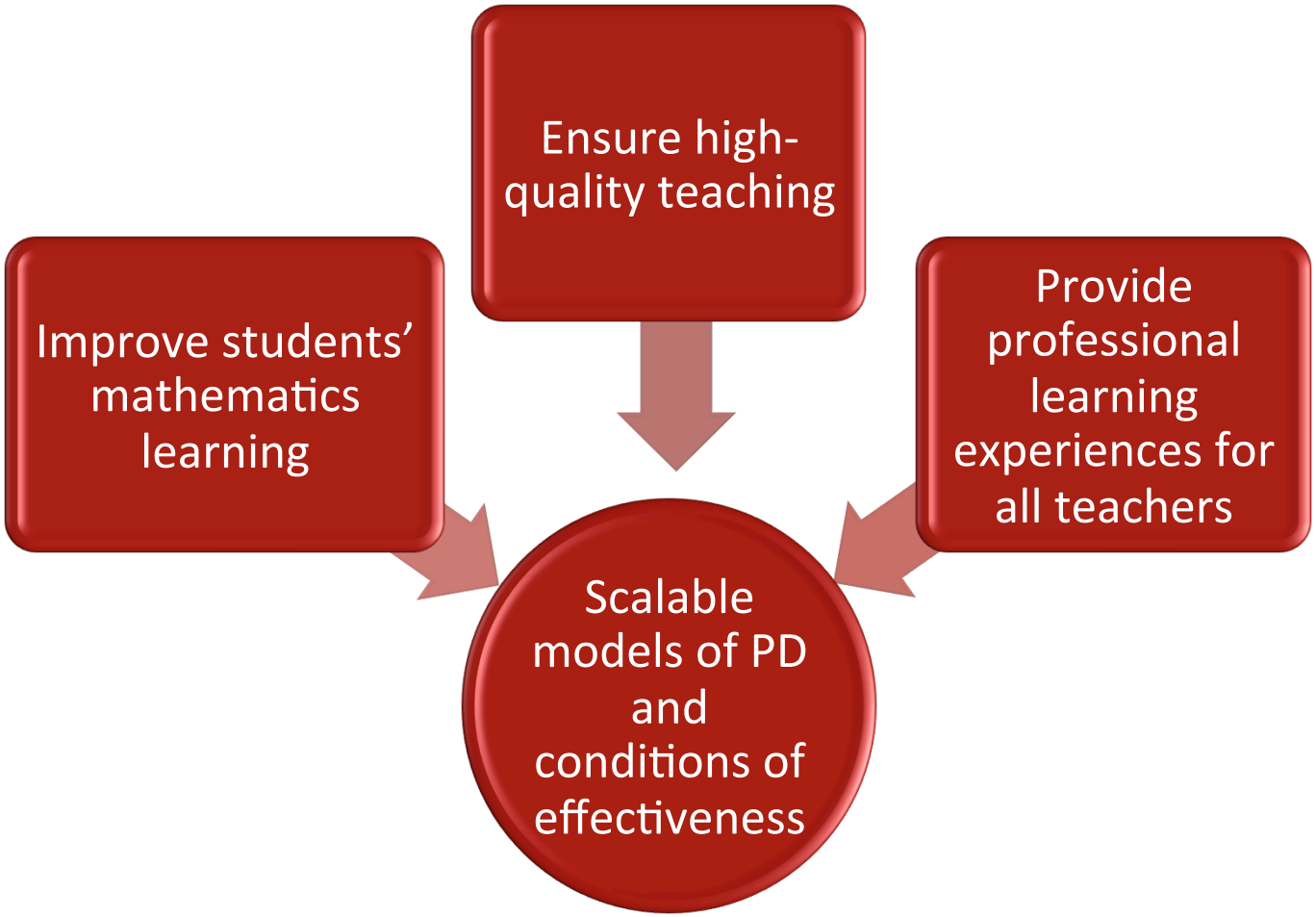
- STEM Director
- Program Administrator for Mathematics
- Mathematics Project Manager
- Math Content Specialists (2)
- Math Leaders (5)

University/District Partnership Coordinator

CSET/UUSD Collaboration

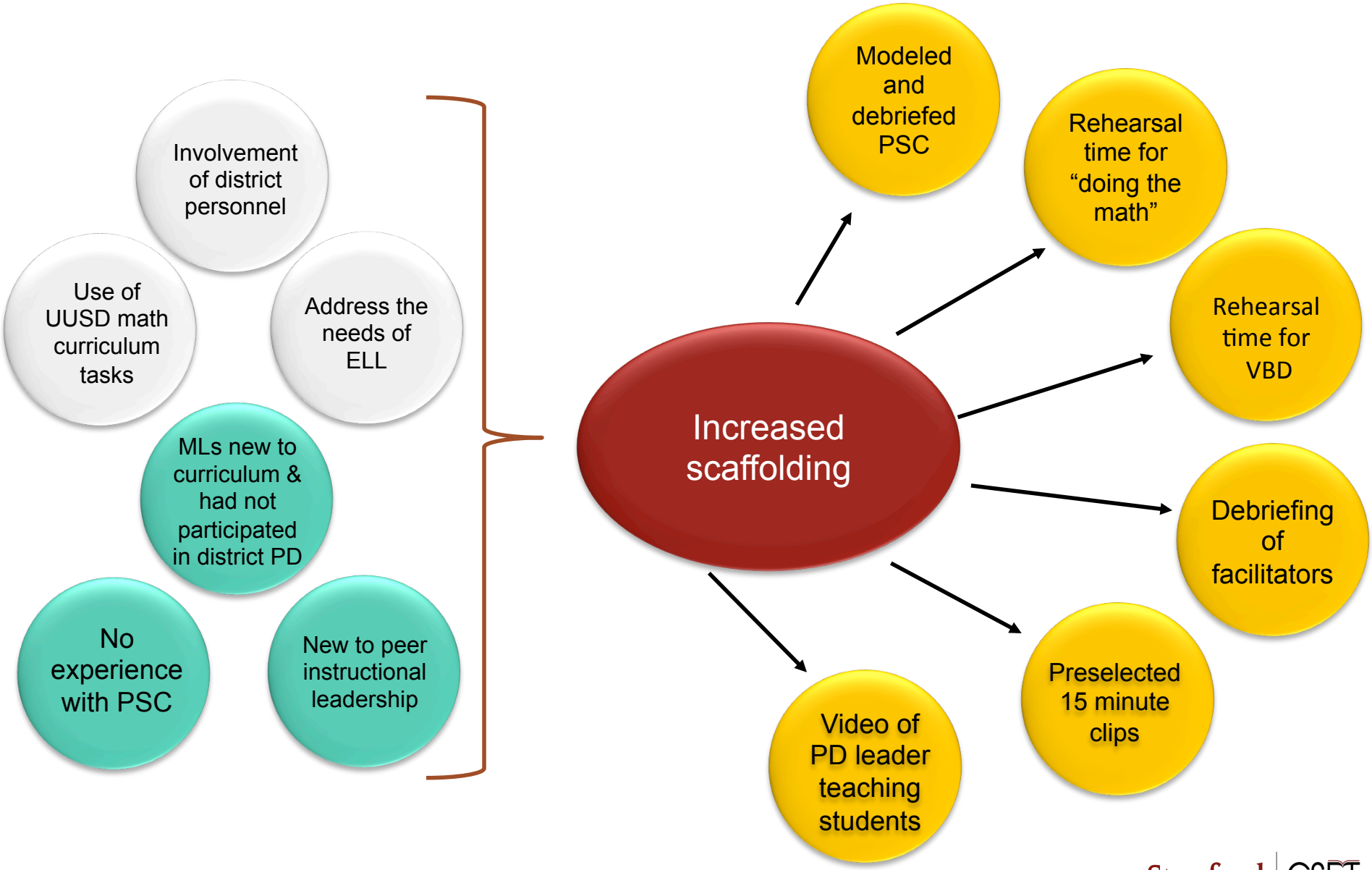
- UUSD Math Core Curriculum units aligned with CCSS, rolled out beginning Fall 2014
- PD by C&I Mathematics Department through Teacher Leader model
- Fit with PSC and MLP models
  - Teaching with rich math tasks
  - Teacher Leader model for site-based PD
- Collaborative work began in Spring 2015

Project Goals



What Influenced the Way We Implemented and Adapted the Models?

Influences → Significant Need → VBD Adaptations

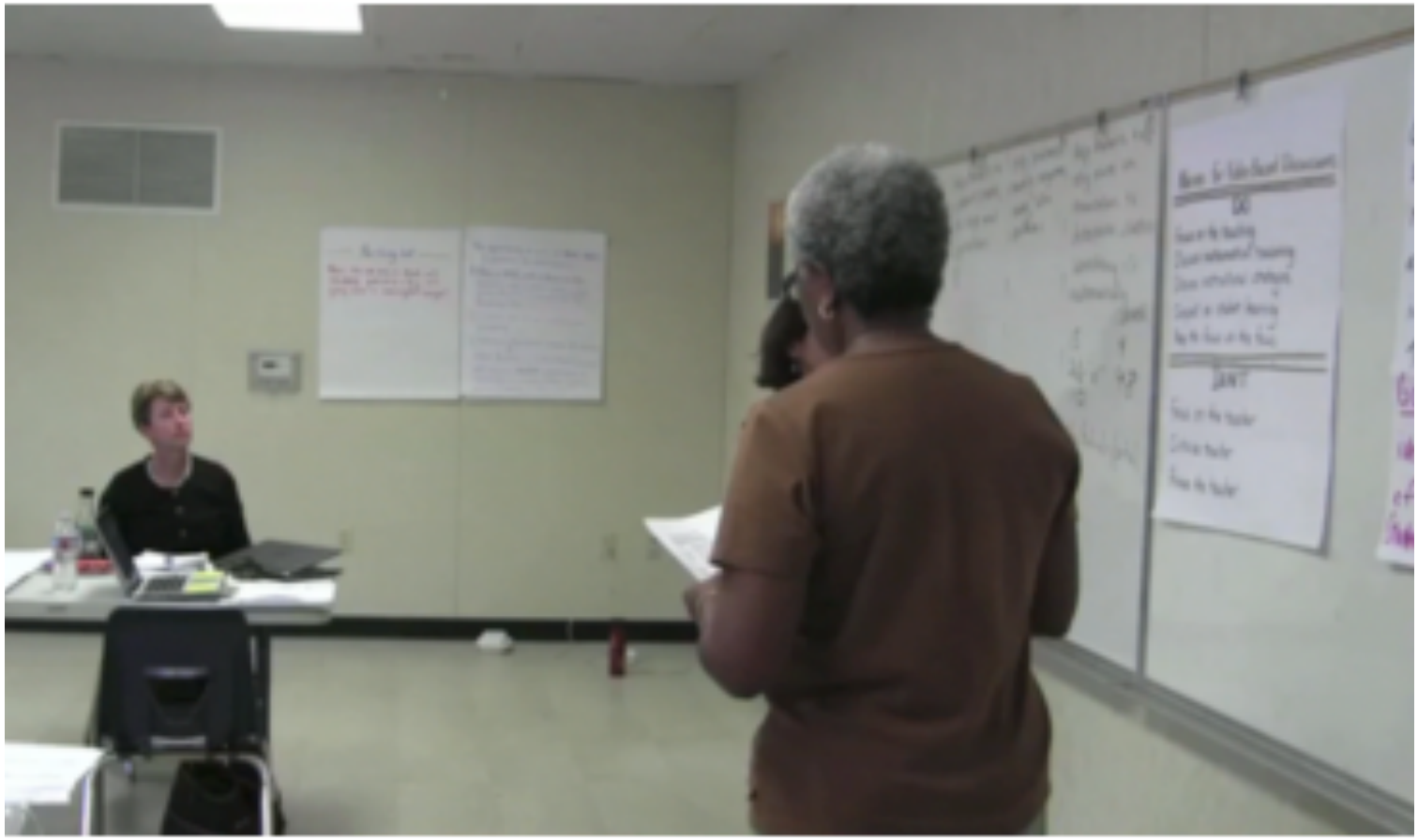


Modeling VBD and Debriefing the Facilitator

Debriefing a VBD after Modeling

- What were your goals for the VBD?
- Why did you select this clip?
- What did you want the teachers to notice and discuss?
- Did you have back-pocket questions to ask? What were some of them?
- Why did you choose to show the clip 3 times?
- Why did you show it without a prompt the first time?
- Was there anything unexpected that came up in the conversation?

Rehearsing a Video-Based Discussion
[VIDEO REMOVED]

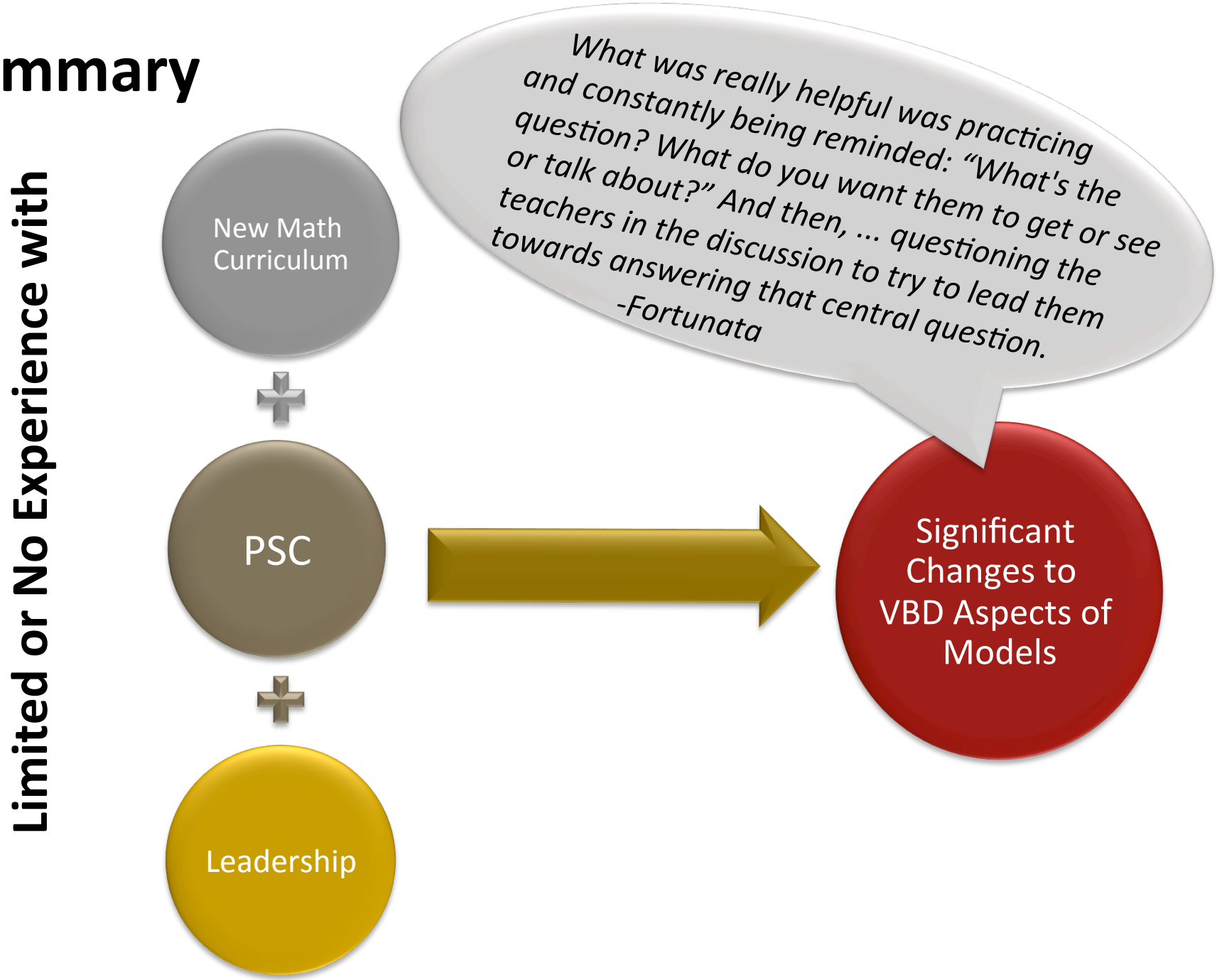


Debriefing a VBD Rehearsal

- Praise
  - I appreciate how you…
  - When you…it really…
  - I never thought about … and when you … it inspired me to think about
- Clarifying Questions
  - What was the intention of…
  - What did you mean by…
  - What was going through your mind when…
- Points of Polish
  - Have you thought about…?
  - Might you consider…?
  - I think maybe if you….”

Debriefing a VBD Rehearsal
[VIDEO REMOVED]

Summary


Limited or No Experience with
New Math Curriculum
PSC
Leadership
What was really helpful was practicing and constantly being reminded: "What's the question? What do you want them to get or see or talk about?" And then, ... questioning the teachers in the discussion to try to lead them towards answering that central question.
-Fortunata
Significant Changes to VBD Aspects of Models

Thank you!

Contact information:

hildab@stanford.edu

janet.carlson@stanford.edu

To learn more about the PSC and MLP models:

www.cset.stanford.edu/psc

Borko, H., Jacobs, J., Koellner, K., & Swackhamer, L. (2015). *Mathematics professional development: Improving teaching using the Problem-Solving Cycle and Leadership Preparation models*. New York: Teachers College Press