# Iterative Model Building: Questioning to Create Geometric Student Thinking Models

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## Overview of Presentation

- Looking at the literature
- Brief overview of research project – Iterative Model Building (IMB)
- Tailoring it to your classroom
- Interactive example

## Questioning Literature

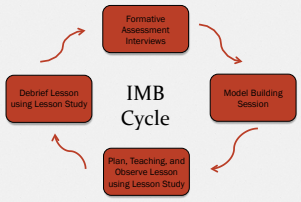
- Questioning encourages students to elaborate on their ideas
- Types of questions (Franke et al., 2009; Moyer & Milewicz, 2002):
  - General Questions
  - Specific Questions
  - Problem Posing
  - Probing Sequences of Questions
  - Leading Questions
  - Checklisting
  - Instructing Rather than Questioning

## Model Building Literature

- Develop pedagogical efficiency through building models of students' knowledge (Carpenter, et al., 1988; Confrey, 1985, 1990; Confrey & Lachance, 2000; Steffe, 2002; Steffe, Cobb, & von Glasersfeld, 1988; Steffe & D'Ambrosio, 1995)
- Gives meaning to teaching experiments by emphasizing students' reasoning (Steffe & Thompson, 2000)
- Models are "descriptive and predictive" (Norton & McCloskey, 2008)

## Iterative Model Building

- Occurs the field experience course in conjunction with math and science methods courses
- Two innovations
  - Focus on students' thinking (Steffe & Thompson, 2000)
  - Focus on collaboration to plan and teach lessons through lesson study (Lewis, 2000)
- Half of the semester focuses on math, half of the semester focuses on science




## Formative Assessment Interviews

- Purpose: to understand students' reasoning
- Preservice teachers work in pairs to design and implement interviews
- Each interview includes two preservice teachers and two elementary students
- Interviews last 15-20 minutes

## Model Building

- Goal: to describe student thinking
- Preservice teachers review Formative Assessment Interview videos to create explanatory models of student thinking
- Models are shared during the next class among their preservice peers

## Example of a Model

- If presented with ten unifix cubes, Jill would be able to make two different same number combinations to get ten. She also can count by ones to get the total number of ten. Her same number combinations are by grouping five and five. Then, her second combination is five groups of two (2+2+2+2+2). However, Jill cannot come up with different number combinations such as 6+4, 2+8, 1+9, and 7+3.

## Lesson

- Purpose: to plan and deliver lessons tailored to students based on student thinking
- Preservice teachers plan and teach whole-class lessons in pairs
- Based on Formative Assessment Interview and Model Building from previous class
- Other preservice teachers record field notes

## Lesson Study

- Purpose: to reflect collaboratively to improve teaching practice
- Discuss ways to change lesson and how to modify future lessons
- Modified version of Lesson Study

## Questioning Examples

- General Questions
  - Why do you think that?
- Specific Questions
  - How many sides are on a square?
- Probing Sequences of Questions
  - What shape is this? How do you know the shape? What characteristics does the shape have that help you identify the shape? Is this shape similar to another shape you know? How are they similar and how are they different?

## Questioning Examples cont'd

- Leading Questions
  - Don't you think that may be a rectangle?
- Checklisting [No follow up questions]
  - What shape is this? What shape is this one?
- Instructing Rather than Questioning
  - This square is a rectangle. Why do you think this square is a rectangle?

## Questioning Benefits

- When in proper context, preservice teachers are able to develop the ability to competently question students.
- Implies that practicing teachers can also develop this ability.
- The ability to develop effective questioning practices is something that can be learned (Weiland, Hudson, & Amador, 2013).
- Being aware of question types and knowing how to question improves practice.

## Formative assessment interviews – How do I use them in my classroom?

- More casual instead of a pull-out situation focusing on just two students
- 2-3 minutes instead of 15-20 min
- Integrated into teaching lesson

## Building models of students thinking – Who has time for this?

- Reflective practice
- Anecdotal notes rather than video transcripts
- Focus on predictive value of the model
- Helps plan for effective and timely lessons

## Let's try it!

- Given the first grade 2D geometry objectives the preservice teachers identified below, what questions would you ask?
  - For student to separate items (both shapes and picture cards) based on attributes.
  - For students to be able to look at a group of items (both shapes and picture cards) and recognize the similarities and differences.

## Clip from Formative Assessment Interview

- Let's watch a small part of the video and see how the students responded.
- 1st Grade Geometry Interview

## Building a Model

- What model could you build based on the clip?
  - What can you say the student does or does not know?
  - What would you predict a student would do given a similar task?
- Evidence to support this?

## Preservice Teachers' Model

- This transcript shows us that at first glance Samantha is only able to see bolder differences within the shapes, she is able to tell that they are different, yet unable to describe why with correct property words. At first when Samantha was given the shapes she knew right away why the rectangle and square were in their own group, yet had a more difficult time describing why the other shapes were together using the correct words.

## Findings from IMB

- Formative Assessment Interviews develop competent questioning (Weiland, Hudson, Amador, 2013; Amador, Vesperman, & Wiebke, 2012)
- Improves Lesson Planning (Amador & Galindo, 2011)
- Provides measure of beliefs and promotes predictive ability (Hudson, Kloosterman, & Galindo, 2012; Norton, McCloskey, & Hudson, 2011)
- Develops reflective ability through Lesson Study (Lee & Galindo, 2011; Tsegai, 2011)

## Questions?

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