Nebraska Summit on Math and Science Education

Making Sense of Sense Making

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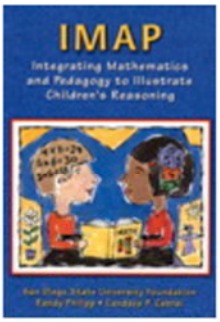
Credit for the videos we are going to watch:

IMAP: Select Videos of Children's Reasoning



The *IMAP: Select Videos of Children's Reasoning* CD contains 25 video clips of elementary school children engaged in mathematical thinking. The CD runs on PC and Mac platforms and comes with an interface that includes the transcript (full or synchronized) and background information for each clip. Also included on the CD is a video guide containing questions for students to consider before and after viewing each video clip, interviews that teachers or prospective teachers can use when working with children, and other resources. The CD is available through Pearson (ISBN 0-13-119854-8.)

http://www.pearsonhighered.com/educator/academic/product/0,,0131198548,00%2ben-USS_01DBC.html

"Elliot," the first of three video clips we will watch, is actually posted on their website:

http://www.sci.sdsu.edu/CRMSE/IMAP/video.html

I encourage you to check out this fabulous resource!

How Does Elliot MAKE SENSE of Mathematics?

Video Clip 16: Elliot

I: Can you work that problem, Elliot?

$$1 \div \frac{1}{3}$$

I: And how did you get that so fast?
C: Umm, 1/3 goes into 1 three times, because there's three pieces in one whole.
I: Can you draw a picture of that?

I: So what have you drawn?
C: One third. And it goes into one whole, if I cut that into thirds, three times. Because I've got one of these. This will connect to this one. This will connect to that one, and this will connect to that one.
I: Is that what division means?

C: Yeah, how many times that goes into that.
I: Okay, nice job!

Time for Elliot to consider: $1\frac{1}{2} \div \frac{1}{3}$

I: Can you explain your answer?
C: Uh huh. Like up there, all you did was add 1/2. So it was—the answer was 3, if I didn't have—so, if this was not there, the answer would be 3. But that is there, and 1/3 goes into 1/2 one time. And now that I've got 1/6 left, 2/6 equals 1/3, and 3/6 equals 1/2. So I take away 2/6, because I'm taking away a third out of the 1/2. And I have 1/6 left.
I: I see just how you thought about that. Nice job!

Participant Notes:

TEAC 892: Teacher Learning about Reasoning & Proving

Likely offered in Omaha for half days during 2 weeks of June
Likely offered online this summer for the first time…

This course focuses on three main issues: exploring the nature of reasoning-and-proving in secondary mathematics; establishing criteria for judging the validity of mathematical arguments; and, developing strategies for modifying current textbook tasks to provide more reasoning opportunities for students. Course materials include math tasks, cases drawn from real secondary mathematics classrooms, related student work, and prompts for mathematical and pedagogical discussions and reflections. This is an excellent course to help secondary teachers make immediate improvements to their mathematics classrooms in order to better prepare students for the NeSA-M.

The course was originally developed by Dr. Maragaret (Peg) Smith, a full professor in mathematics education from the University of Pittsburg, as part of an NSF funded grant entitled Cases of Reasoning-and-Proving in Secondary Mathematics (CORP).

"This is the first class that I have taken that focuses on how to use reasoning and proof in the classroom. I liked that we discovered and debated the difference between proof and rationale by looking at numerous examples of 'proofs.' To me, this has always been a gray area, and it was helpful to hear arguments from colleagues across the state. This is one of the best classes I have taken because the concepts that we learned can and should be used in all classrooms. The strategies are not specific for any one class, and have further stretched me as a teacher. You have the opportunity to learn a lot about yourself and improve the way you teach." Carrie Kopf, Norfolk Public Schools

"This class involves a great deal of interaction and the time passes quickly because you can't help but be engaged. You will broaden your network of resources by connecting to other teachers throughout the state and get the chance to learn from their experiences. This class has been known to convince people to change their entire teaching focus. It is very powerful! Everything you will learn aligns with the common core and NCTM standards. If you became a teacher to make a positive impact in your student's lives then you owe it to them to take this class." Sherry West, Lincoln Public Schools

I have found *Teacher Learning about Reasoning & Proving* to be so profound and practical. In this course I have learned to use the same textbook that I have been using on a daily basis that produces students who seek guidance for every incremental step, to engage them in reasoning, explaining, representing, generalizing, communicating, and growing their mathematical knowledge. I no longer have to complain about what my textbook does not do for me because I can now modify its tasks to serve the purposes I desire for myself. I feel empowered, like I am driving my classroom and the learning rather than rendering my judgment over to the textbook or feeling pressured to hunt down an assortment of outside resources." Marlene Grayer, Omaha Public Schools

TEAC 892
Hall of Fame!

2012

- Bret Beermann
- Karen Clinch
- Bailey Feit
- Wendi Herbin
- Tony Jacobsen
- Kyle Kalail
- Carrie Kopf
- Julianne Meier
- Heather Peters
- Sam Robb
- Keith Schroetlin
- Sarah Scofield
- John Sweeney
- Gina Vifquain
- Jason Vitosh

2013

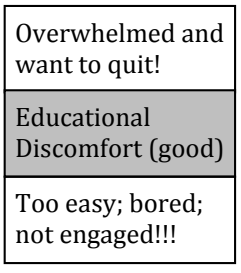
- Ashley Fanciullo
- Sarah Fischbein
- Matt James
- Laura Janssen
- Jeff Meyer
- Tiffany Powers
- Emily Romkema
- Angie Schroetlin
- April Sypal
- Sherry West
- Courtney Wichman

2014

- Jeff DeVries
- Marlene Grayer
- Jeremy Jank
- Michelle Milana
- Laura Novak
- Kirk Ortegren
- Anessa Price
- Ashley Speak
- Alyssa Straube
- Ryan Voelker

2013 Teacher moves that promote reasoning-and-proving

- Wait (Give Wait Time…especially after questions **and** after student answers)
- Question students, even if "they" are right
- Give students "true" problem solving opportunities
- Practicing asking mathematical questions from _____ prompt (picture)
- Have students write down their thoughts and explanations
- Think, (Write), Pair, Share
- Precision/Attention to Detail
- Never Say What a Student Could Say…(teachers being less helpful)
- Explaining reasoning to peers
- Make students verbalize their processes
- Partner Coaching / Simon Says
- Building students confidence with a low entry point
- Giving student opportunity to learn the difference between power of If-Then (cause & effect) vs. correlation…nice pattern
- Allowing time for a blank stare to turn into an Aha
- Model to students (Think alouds, etc…)
- Encouraging healthy skepticism
- Convince yourself, convince a friend, convince a skeptic
- Asking "What would happen if?" "Why" ….on a REGULAR basis
- Not giving students the correct answer; students have to verify it…
- Ask another student to rephrase in a different way what student "A" said—including if someone in a group has a hand raised…then ask another in the group to "talk/ask"
- Have students answer each others' questions
- Validate student thinking even when its wrong…misconceptions can lead to much growth
- Introducing topics with non-routine math problems (e.g., golden apples)
- When lesson planning, focus more on what students will be doing than that what you are telling (further—find engaging math problems, think about student misconceptions and questions to direct them, think about multiple representations, plan out possible questions to direct problem solving…be prepared to "change up" your lesson plan)
- Alternative assignments that make students think—quality over quantity
- Building a sense of trust and community…
- Promote using alternative methods
- Promote questioning
- Low entry → high ceiling problems
- Scaffolding or guiding…working to keep them in learning zone
- <u>More</u> Guiding/Less Scaffolding at beginning of year….
  Less guiding / <u>More</u> Scaffolding at the end of the year
- Modify homework assignments (including directions)
- Modify the "order" in which you order the homework problems
- Asking students to write out their explanations



2013 Strategies for Modifying Tasks to Enhance Students' Opportunities to Reason-and-Prove.

- Give less procedure, but ask for more reasoning
- Add scaffolding steps **<u>or</u>** take them out…
- Begin with exploration tasks to lower to point of entry
- Use patterns to generate conjecture
- Ask students to justify or explain their reasoning
- Ask students to write/explain…something about the problem
- Give students time to think
- Delete information students can find for themselves
- *Don't give information to your students that your students can figure out!*
- Allow for multiple methods
- Re-order questions
- Ask students to make connections with models (including geometric, numeric, verbal, algebraic)
- Remove mathematical structure from the problem (let students build it!)
- Self analysis – self reflection

2012 Strategies for Modifying Tasks to Enhance Students' Opportunities to Reason-and-Prove.

- Changing, possibly removing, directions
- No labeling (type of problem…like "prove…problem solving…")
- Remove unnecessary scaffolding (don't tell the steps…)
- Be careful on how you add in scaffolding
- Loosen the structure of the problem
- Use multiple empirical cases first to help students build toward a more general understanding
- Focus students on their prior knowledge (what do you see, what do you observe in the diagram, list what you know, brainstorm…)
- Ask students to conjecture; ask students to check the validity of their conjecture
- Be specific to make sure students WILL prove something
- Offer opportunities for students to reflect on what they have done
- Possibly just re-order what the "book" suggested