

### **Unit 3 Students as Powerful Doers of Mathematics**

#### **Day 1 – Teacher moves that can increase access, agency, ownership, and identity & the Teaching for Robust Understanding Math framework**

“Traditional methods of math instruction do not allow for much questioning, investigating or individual development of understanding. Inquiry based mathematics instruction allows for all of this to take place in the classroom and opens up the doors for students to answer their own questions by exploring meaningful real-life problems that incorporate several mathematical concepts into one problem.”

Ferguson, K. (2010). *Inquiry based mathematics instruction versus traditional mathematics instruction: The effect on student understanding and comprehension in an eighth grade pre-algebra classroom* (Masters Thesis). Cedarville University. *Master of Education Theses & Projects*. Paper 26. [http://digitalcommons.cedarville.edu/cgi/viewcontent.cgi?article=1025&context=education\\_theses](http://digitalcommons.cedarville.edu/cgi/viewcontent.cgi?article=1025&context=education_theses)

#### Teaching for Robust Understanding (TRU) Framework

<http://map.mathshell.org/trumath.php>

#### TRU Framework: The Five Dimensions of Powerful Classrooms

[http://map.mathshell.org/trumath/tru\\_cg\\_domain\\_general\\_20160902.pdf](http://map.mathshell.org/trumath/tru_cg_domain_general_20160902.pdf)

#### Darryl's Article

Yong, D. (2012). Adventures in teaching: A professor goes to high school to learn about teaching math. *Notices of the American Mathematical Society*, 59(10), 1408–1415.

#### Deborah Ball Video: Mamadou-Half-Rectangle

Ball, D. L. (2010, March 28). Mamadou-Half-Rectangle [Online]. *Mathematics Teaching and Learning to Teach*. University of Michigan. <http://hdl.handle.net/2027.42/78024>

#### Slope Triangle Tasks

Reflecting on Practice 2017– Gail Burrill

##### Access to Content

Level 1- differential in access to content and no attempt to address

Level 2- uneven access to content and teacher makes some effort to address

Level 3 – teacher actively supports and to some degree achieves meaningful math participation

##### Agency, Ownership, Identity

Level 1 – teacher initiates, students have short responses, constrained by what teacher said

Level 2 - students explain but teacher decides correctness; ideas not built on in discussion

Level 3 - students explain their ideas and reasoning; students respond to each other; teacher credits students with ideas

### **Unit 3 Students as Powerful Doers of Mathematics**

#### **Day 2 – Access and agency, ownership, & identity from the perspective of a learner with a statistics task**

As students learn new concepts through argumentation, they also come to see mathematics as a creative human endeavor to which they can contribute. Consistent with current socio-constructivist views of learning, inquiry methods emphasize individual knowledge construction supported by peer social interactions.”

Kogan, M., & Laursen, S. L. (2014). Assessing long-term effects of inquiry-based learning: A case study from college mathematics. *Innovative Higher Education*, 39(3), 183–199.  
<https://doi.org/10.1007/s10755-013-9269-9>

#### Gallup Quote 2016

76% of US parents are completely or somewhat satisfied with the quality of education their child is receiving, but only 43% of US adults agree

[http://www.gallup.com/poll/194675/education-ratings-show-record-political-polarization.aspx?g\\_source=Education&g\\_medium=lead&g\\_campaign=tiles](http://www.gallup.com/poll/194675/education-ratings-show-record-political-polarization.aspx?g_source=Education&g_medium=lead&g_campaign=tiles)

#### Margin of Error Task

Gail Burrill RoP 2017

#### Teaching for Robust Understanding (TRU) Framework

<http://map.mathshell.org/trumath.php>

## **Unit 3 Students as Powerful Doers of Mathematics**

### **Day 3 –Strategies that shift agency, ownership and responsibility for learning to students**

“Properly designed inquiry lessons will provide students with the opportunity to investigate, debate, and challenge what they know.”

Hmelo-Silver, C. E., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: a response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist*, 42(2), 99-107 as cited in Brune, M. C. (2010). *The inquiry learning model as an approach to mathematics instruction* (Masters thesis). Boise State University. Retrieved from <http://scholarworks.boisestate.edu/cgi/viewcontent.cgi?article=1161&context=td>

#### Round Robin Questions

Everyone at the table should ask at least one question they have and see if anyone in the group can answer the question. If not, make note of the question. Go around in consecutive order until everyone in the group has no more questions or the questions need the rest of the class to answer.

#### Teaching for Robust Understanding (TRU) Framework

[http://map.mathshell.org/trumath/tru\\_observation\\_guide\\_v5\\_20161127.pdf](http://map.mathshell.org/trumath/tru_observation_guide_v5_20161127.pdf)

#### Students Assume Responsibility for Their Own Learning Quote

“Provide opportunities for students to assume more responsibility over their learning, arousing confidence to engage actively with mathematics.”

Schoenfeld, A. (2013). Classroom observations in theory and practice. *ZDM Mathematics Education*, 45(4), 607–621. <https://doi.org/10.1007/s11858-012-0483-1>

#### Student Self-Assess Quote

“Also, I think it's important to share the idea of flow with students so that they can self-assess and think about what moves THEY can make to keep themselves there!”

ROP reflection 2017

#### Which One Doesn't Belong Protocol

Each participant should write his/her name in the upper left corner of the board with their assigned color marker, then identify one cell that doesn't belong by drawing a line from the cell to their name and writing a reason why on the line. List of the mathematical concepts used.

#### Graphing Equations from Given Information Video

TIMSS Video United States Mathematics Lessons US1 Linear Equations

<http://www.timssvideo.com/videos/mathematics/United%20States>

#### Sorting Triangles Video

PRIMAS Inquiry-based learning activity with a form 1 class at St Clare College

<http://educationaldesigner.org/ed/volume3/issue9/article30/index.htm?&popups=off>

#### TRU Framework Things to Think About List

[http://map.mathshell.org/trumath/tru\\_cg\\_domain\\_general\\_20160902.pdf](http://map.mathshell.org/trumath/tru_cg_domain_general_20160902.pdf)

### **Unit 3 Students as Powerful Doers of Mathematics**

#### **Day 4 – Teacher moves that can increase access and agency, ownership & identity including the importance of planning and classroom norms**

“The interchangeable and loose use of the term “inquiry” makes it difficult to discern and elicit clear characteristics of inquiry practice, and this raises a number of important issues. One issue that seems problematic with the term inquiry is that, while it defines an *activity*, it may also be seen to describe a process.”

Calleja, J. (2016). Teaching mathematics through inquiry: A continuing professional development programme design. *Journal of the International Society for Design and Development in Education*, 3(9). Retrieved from [https://www.researchgate.net/publication/311824056\\_Teaching\\_Mathematics\\_through\\_Inquiry\\_A\\_Continuing\\_Professional\\_Development\\_Programme\\_Design](https://www.researchgate.net/publication/311824056_Teaching_Mathematics_through_Inquiry_A_Continuing_Professional_Development_Programme_Design)

#### Lesson Plan for Mamadou-Half-Rectangle by Deborah Ball

[https://deepblue.lib.umich.edu/bitstream/handle/2027.42/78024/eml2007\\_lessonplan\\_071707\\_abridged.pdf?sequence=4&isAllowed=y](https://deepblue.lib.umich.edu/bitstream/handle/2027.42/78024/eml2007_lessonplan_071707_abridged.pdf?sequence=4&isAllowed=y)

#### TRU Framework Planning

[http://map.mathshell.org/trumath/tru\\_cg\\_domain\\_general\\_20160902.pdf](http://map.mathshell.org/trumath/tru_cg_domain_general_20160902.pdf)

#### Group Collaborative Task Video – Inside Mathematics Website

<http://www.insidemathematics.org/classroom-videos/building-classroom-climates-for-mathematical-learning/secondary/engaging-in-mathematical-discourse/day-3-group-collaborative-task-for-precise-communication-and-structured-talk>

#### TRU Framework Observation Guides

[http://map.mathshell.org/trumath/tru\\_observation\\_guide\\_v5\\_20161127.pdf](http://map.mathshell.org/trumath/tru_observation_guide_v5_20161127.pdf)

#### Lesson Planning Task

Question 1: How will you provide opportunities for all students to generate and explain their own ideas? To respond to each other’s ideas (agency, ownership and identity)?

Question 2: How will you provide opportunities for all students to participate in the intellectual work of the class (access)?

Question 3: How will you select student work for sharing (assigning competence)?

Horn, L. (2012). *Strength in numbers: Collaborative learning in secondary mathematics*. Reston, VA: National Council of Teachers of Mathematics. p. 64.

### Norms for Students

- Take turns
- Listen to others ideas
- Disagree with ideas not people
- Be respectful
- Helping is not the same as giving answers
- Confusion is part of learning
- Say your “because”
- “I can’t do that yet”

Horn, L. (2012). *Strength in numbers: Collaborative learning in secondary mathematics*. Reston, VA: National Council of Teachers of Mathematics.

### Norms for Teachers

- Listen for what can be learned about students' thinking rather than for correct answers
- Identify & check a “hinge point” in the lesson where student understanding is critical for moving on
- “No hands up, except to ask a question” (Leahy et al, 2005)
- Be relentless in asking what does it mean/why it works
- Maintain neutral stance with respect to answers
- Record responses so everyone can think about them
- Wait time before responses/after response
- Deflect questions to students-“Never say anything a kid can say”
- Plan, plan, plan questions/discussion in advance

Gail Burrill NCTM 2013