

Research in Action: Making Classroom Discourse More Productive and Powerful

NCTM Regional Meeting
Nashville, TN
November 2015

Overview of presentation

- Part 1: Intro to our work
 - Professional development: Math discourse in secondary classrooms (MDISC)
 - Core discourse-related tools and constructs
- Part 2: Teacher-researchers
 - Laurie Busby, 8th grade
 - Dean Hanton, 7th grade
 - Evelynne Pyne, 7th grade
 - Leah Jones, 8th grade
 - Jodi Wheeler, high school (former Math Coach)

[Other team members: Cyndi Goff, Kyle Haskell, Cindy Loeffert]
- Part 3: Questions and discussion

Part 1: Intro to Our Work

Overview of Mathematics Discourse in
Secondary Classrooms (MDISC) (Herbel-Eisenmann,
Cirillo, Steele, Otten & Johnson, forthcoming from Math Solutions)
+ Core Discourse-Related Tools & Constructs

Mathematics Discourse in Secondary Classrooms (MDISC)

- **Designed *practice-based* professional development materials for secondary mathematics teachers, focused on *classroom discourse***
 - *36-40 hr. study group + about 2 yrs.*
- **Overarching goal is for teachers to be *purposeful* about their *classroom discourse practices* so that they are *powerful* for students'**
 - *anything people do to communicate with one another, including speaking, writing, drawing symbols or other representations, gesturing and other nonverbal communication, and so on.*
 - *Productive practices* **enrich the classroom discourse** and **access to mathematical content**
 - *Powerful practices* **enrich the classroom discourse** and **support students' (positional) identities as knowers and doers of mathematics.**" (Esmonde, 2009, p. 250)

Mathematical tasks; videos or transcripts, student written work, textbook pages; "Connecting to Practice" assignments; short summaries of key ideas

Discourse tools: Teacher Discourse Moves

Interpretive discourse lenses:

Language Spectrum (& Math Register)

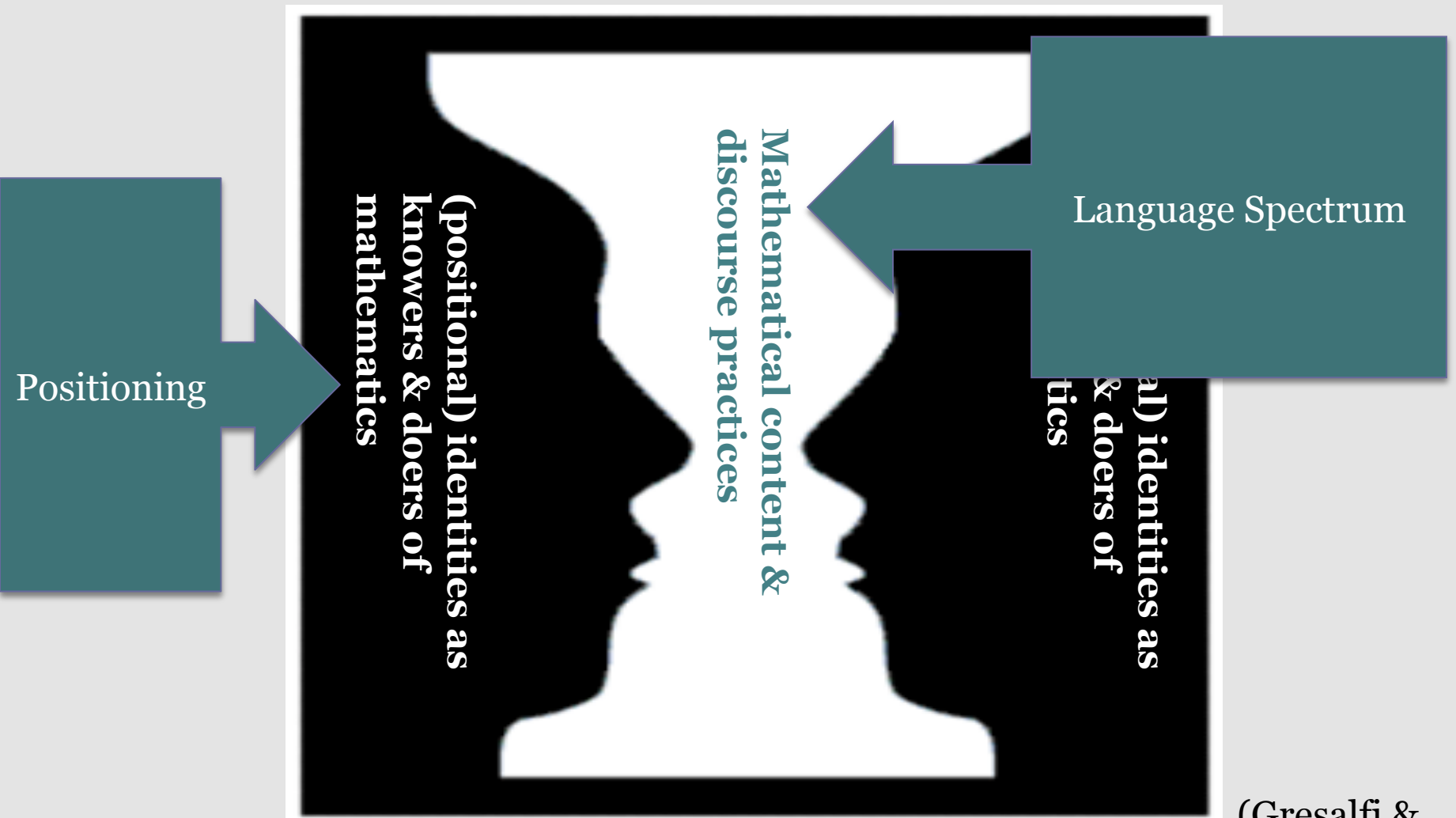
Positioning

Teacher Discourse Moves (TDMs) (based on modified “talk moves” proposed by Chapin, O’Connor & Anderson, 2003)

- Inviting student participation
- Waiting
- Probing a student’s thinking
- Revoicing
- Asking students to revoice
- Creating opportunities to engage with another’s reasoning

Alternative moves to use in place of the pervasive
Initiate-Respond-Evaluate (IRE)

Opportunities to learn: access to...



(Gresalfi & Cobb, 2006)

Consider how language changes as...

- a small group of students work at their desks to try to solve a mathematical task;
- one student from that group is asked to report out their solution to other students after the groups worked on the task;
- a student might write up a formal explanation; and
- textbook explanation

Communication Context	Type of Text Typically Produced	Some Common Characteristics of the Text
Small group work		
Whole class reporting out		
Student written solution		
Textbook		

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Small group work	Language of Interaction	Pointing; context dependent; references to mathematical terms/processes not very precise
Whole class reporting out		
Student written solution		
Textbook		

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Small group work	Language of Interaction	Pointing; context dependent; references to mathematical terms/ processes not very precise
Whole class reporting out	Language of Recounting Experience	More specific and explicit; more mathematically precise; some logical connectors but also time connectors; usually past tense; human actors (I, we) and action verbs
Student written solution		
Textbook		

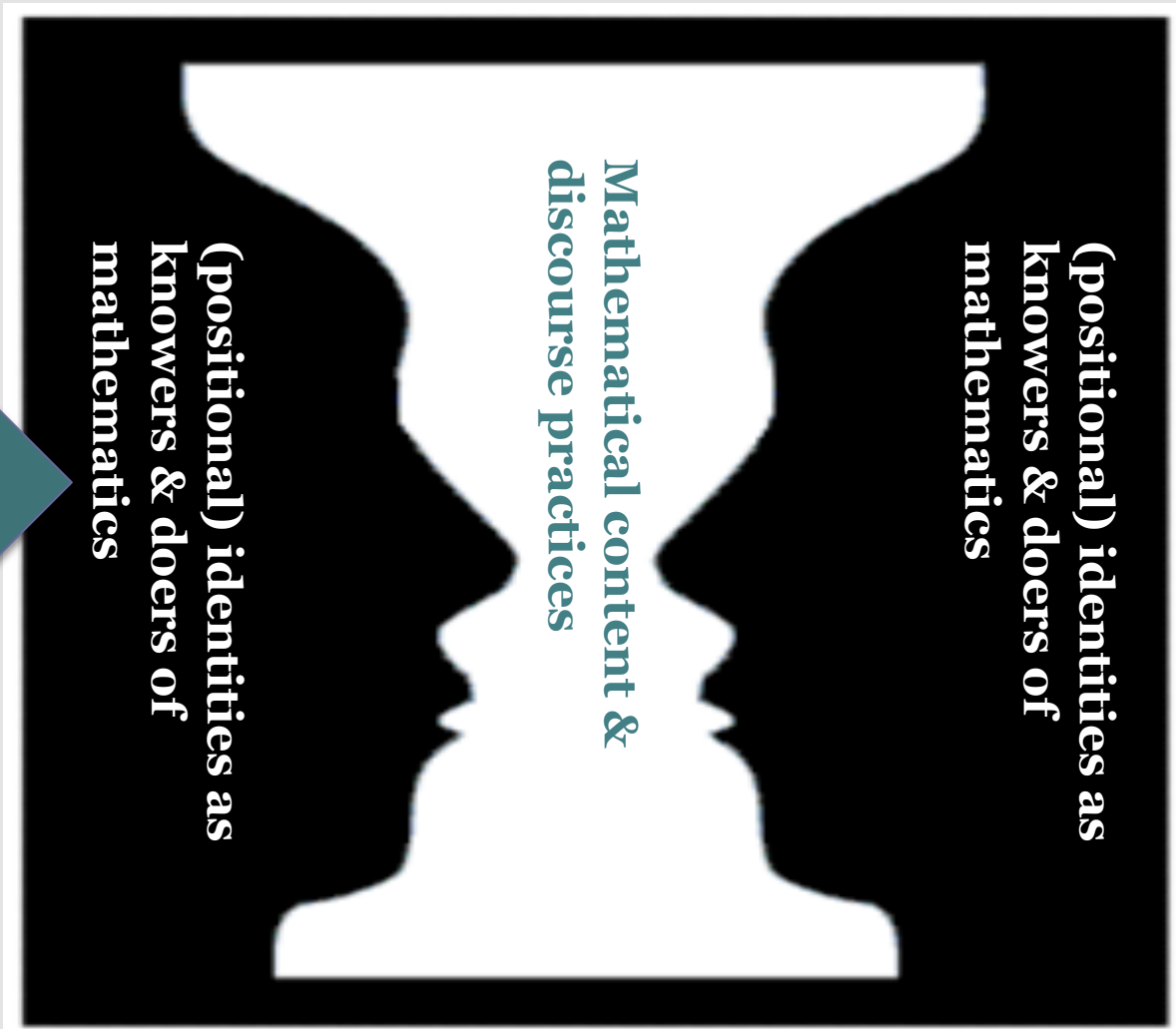
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Textbook		

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Student written solution	Language of Generalizing Experience	More specific and explicit; explain and justify what did, “you” or mathematical objects as actors, logical connectors, more mathematically dense and precise, timeless present tense
Textbook	Similar to the Mathematics Register	Most specific, explicit, and precise; dense phrases; no human actors; nominalizations; logical connectors; many symbols; many relational verbs

Language Spectrum (based on the mode continuum described by Gibbons (2003, 2004, 2006, 2008, 2009))

- Focuses attention on how language changes based on “communication context”
- Highlights the importance of using language in multiple ways to develop meaning
- Describes movement from context-dependent language to more abstract and discipline-based use of language-important to scaffolding students’ discourse practices

Opportunities to learn: access to...



(Gresalfi & Cobb, 2006)

Positioning

(based on van Langenhove & Harré (1990))

...the ways in which people use action and speech to arrange social structures... recognizes that there can be multiple kinds of conversation happening in any mathematics classroom, each of which assigns fluid roles to the participants. (Wagner & Herbel-Eisenmann, 2009)

- People can position themselves &/or others
- Not necessarily intentional
- Happens all the time
- Supports (and has consequences for) the development of disposition (Gresalfi, 2009) and identity (Anderson, 2009)

Positioning

- Between/among people
 - **Student-student** (status, competence)
 - **Teacher-student** (authority, agency)
 - *Who is considered knowledgeable in my classroom? About what (e.g., procedures? concepts? reasoning)? Whose voice is being heard? In what ways? Who is considered a 'struggling' learner?*
- What it means to know and do mathematics
 - *Is mathematics about procedures, concepts and/or something else? What kind of mathematical practices (e.g., argumentation, explanation, just answers) do we engage in? What is emphasized, thinking processes or doing processes? Do we generate mathematics collaboratively or is it something done individually?*

Representational context, communication context, math register

Stop & notice/identify instances of TDMS in the cases...

Using ideas from the **Language Spectrum**, what do you see happening around the TDM?

In what ways, then, might the discourse be **PRODUCTIVE** for student learning? What might be done differently?

Teacher Discourse Moves

Using ideas about **Positioning**, what do you see happening around the TDM?

In what ways, then, might the discourse be **POWERFUL** for student learning? What might be done differently?

Status, competence, authority, agency, what it means to know/do math

Waiting; *Inviting* student participation; *Revoicing*: *Asking* students to revoice; *Probing* a student's thinking; *Creating* opportunities to engage with another's

Timeline of our work together

- 2012-2013: ELMS, Full MDISC study group
 - Dean, Evelynne & Laurie (+ another 8th grade teacher)
- 2013-2014: ELMS, 'group' action research
 - Dean, Evelynne, Laurie & Leah
- 2014-2015: ELMS, individual action research (and Connecting to Practices)
 - Dean, Evelynne, Laurie, Leah
 - Jodi Wheeler (math coach + inclusion)
 - Cindy, Cyndi, & Kyle
- 2015-2016: ELMS, individual action research
 - Cyndi, Cindy, & Kyle
 - Dean & Evelynne
 - Laurie & Leah
 - Jodi

What have we been doing?

- Meet about 2x a month
 - After school: check in & troubleshoot/share updates
 - Half day: data analysis & sharing
- Data collection
 - Video recordings, Exit cards, Surveys, Weekly journals, Student written work
- Analysis
 - What claims might you make about your action research focus?
 - What evidence do you have for your claims?

Common goal

To create classroom environments in which students are:

- a) actively involved in communicating about mathematics;
- b) coming to see mathematics as something that makes sense; and
- c) gaining confidence in themselves as people who can know/do/understand mathematics.



Laurie Busby

8th grade mathematics

My Awakening

Year 31

Before Our Work

- My Classroom was about CONTROL
- Student success was measured by:
 - scores on exams and assignments
 - student or parent acknowledgement/feedback
- My Focus was on:
 - Positive feedback
 - The majority of students were understanding and those that were not, were very few and perhaps not successful as a result of factors beyond my control
- Students would gain access to mathematics concepts primarily through my instruction
 - IRE
 - Students' contributions were short and “right answer” directed

Beginning Our Work

Productive

- I speak with every student every day.
- I see each student's work (sometimes lack thereof) and have a daily interchange with them.
- More students are participating during whole group discussion. I have become more of a facilitator of discussion than a disseminator of information.

Powerful

- We are creating a culture of valuing input from all students each day and consider this as we plan our lesson activities and classroom discussions.
- We consider that how students see themselves as knowers, doers and thinkers of and about mathematics is vital.

As a Result of our Work

Jump Starts

Name _____

Response Sheet

Dates _____ to _____ Hour: _____

Describe how your participation or the participation of a classmate has helped you better understand something, helped you feel more comfortable about your own thinking or made you see yourself as more of a successful math thinker, doer or learner.

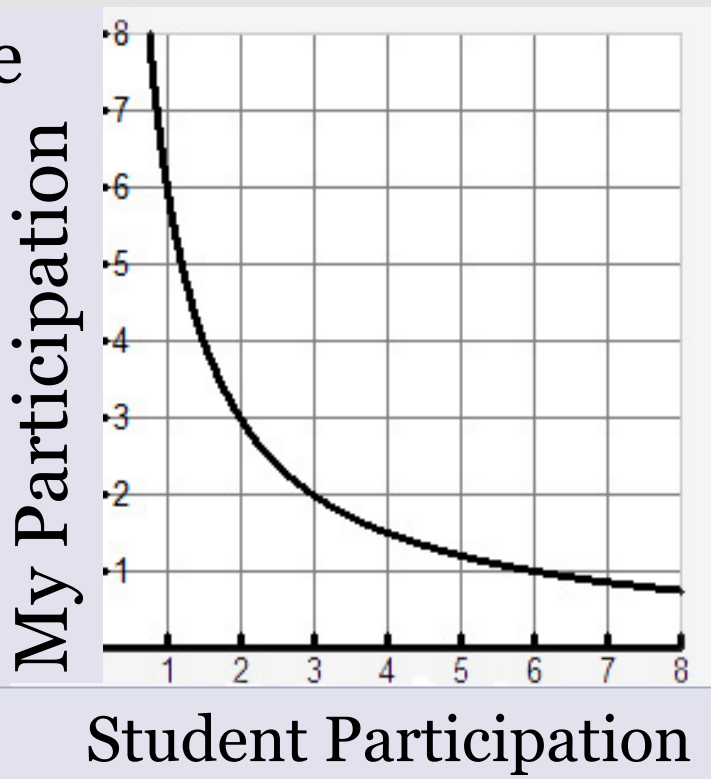
Yesterday when Lucas shared how to estimate the square root of a non-square number, I really understood. Before that, I did not know how to do it at all.

<i>Jump Start Topic</i>	<i>Jump # Start</i>
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1

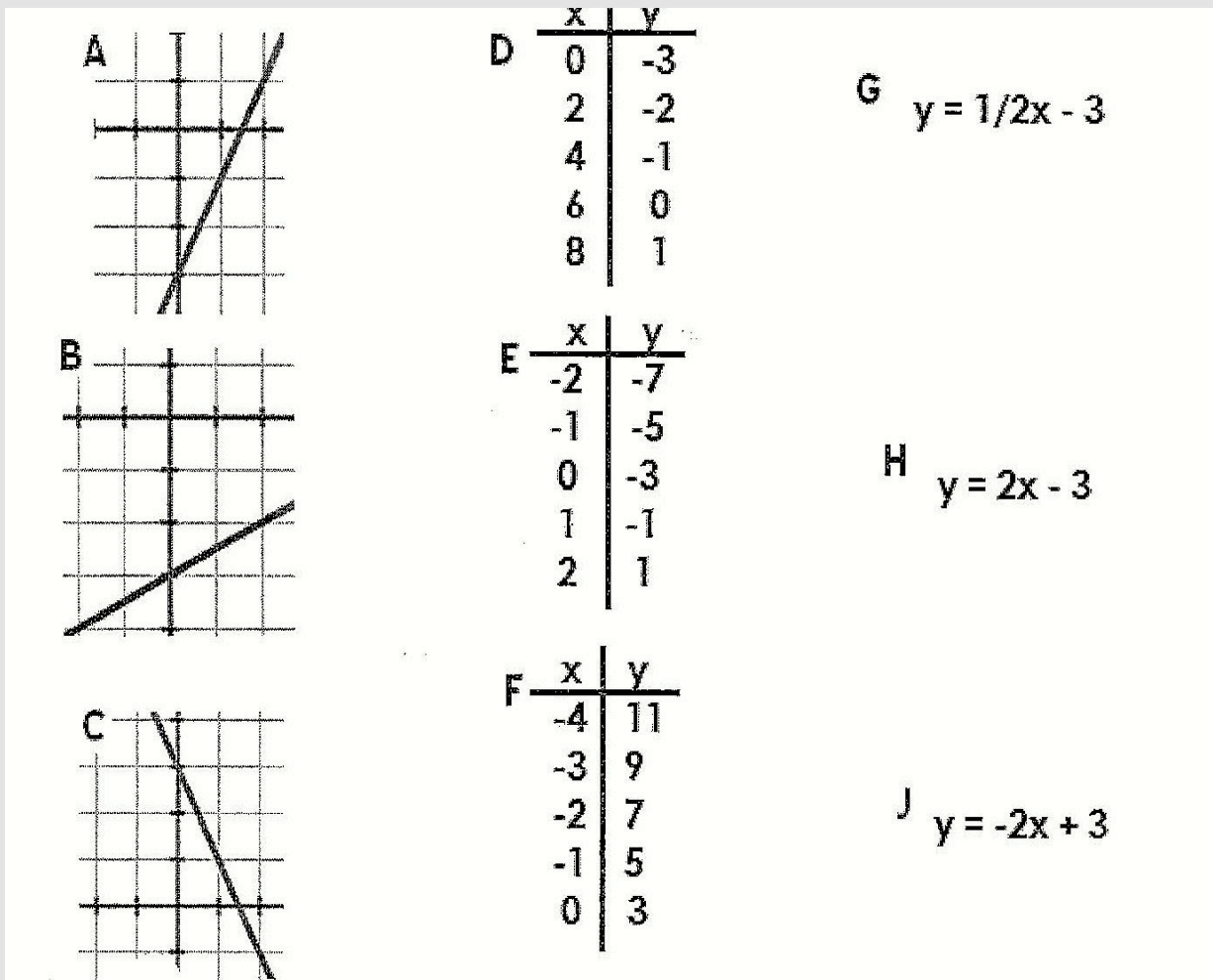
2

$y=kx$ Where **y** is the teacher participation time in discussion and **x** is the student participation time in discussion and **K** is the constant of variation=> evidence of student brilliance



X Student Participation	Y Teacher Participation
Listen	Full lecture and demonstration
Listen and respond when called upon	IRE
Listen, respond when called upon, and ask questions	Probing and inviting (student to teacher)
Listen, respond when called upon, ask questions and work with peer group	Create opportunities for student engagement within peer groups
Brilliance!	Facilitating powerful and productive discourse (student to student)

The contrast: An example from spring 2015



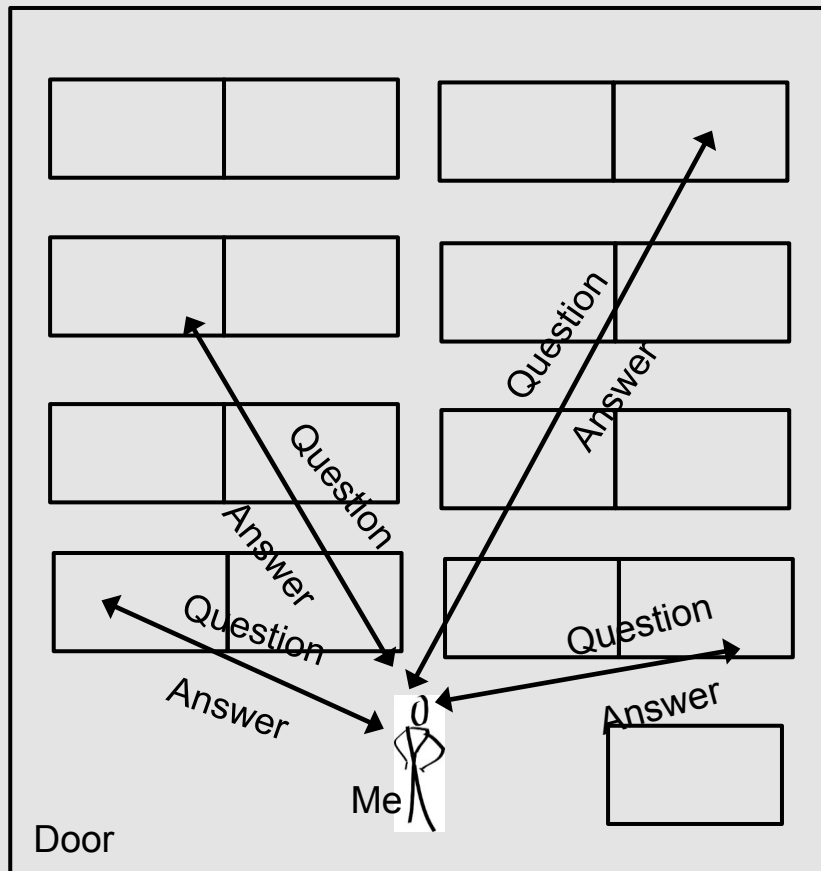
The contrast: An example from Spring 2015



Dean Hanton

7th grade mathematics

Where I come from...



I talked... a lot...
they listened
I asked questions...
I already knew the answer
I gave them facts...
They wrote them down
I moved on...
They were ready (or not)

A typical interaction...

What was the cost for 4 pounds at each store?

\$8 and \$6.00

Which cost more?

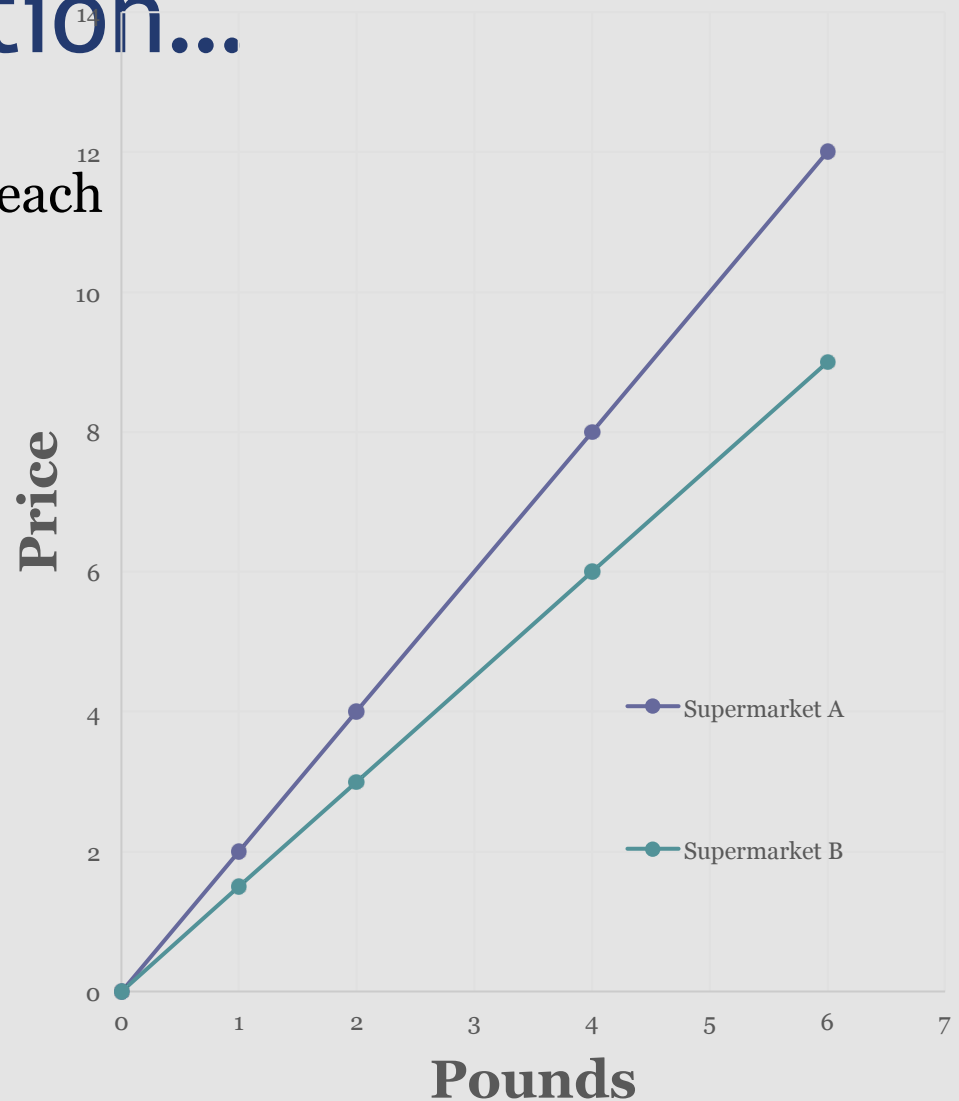
Supermarket A

How much does each pound cost?

\$2 and \$1.50

This is called the...

Unit Price



I was often left begging
for participation...

Please...?

Revoicing, and my conversion

Revoicing: restating, rephrasing, or expanding on a student contribution.

Why would I do this? I just said it once...weren't they listening?

Then I started trying it, over and over again.

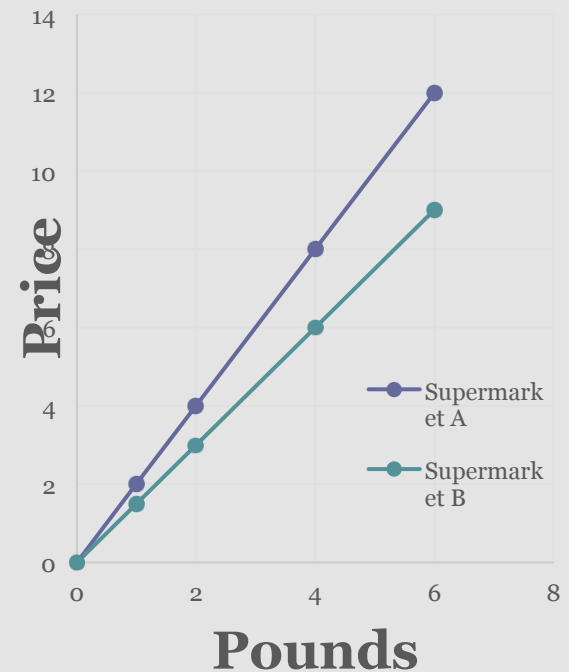
Remember the graph?

A different conversation

Student: The higher unit price will have a more steeper graph because it's going up more each time.

Me: I heard you say it's going up more each time. What do you mean by that?

Student: When you add a pound, the price goes up two dollars instead of one-fifty, so the points will be higher and the line will go up faster, because the unit price is higher.



Still too much me, but better



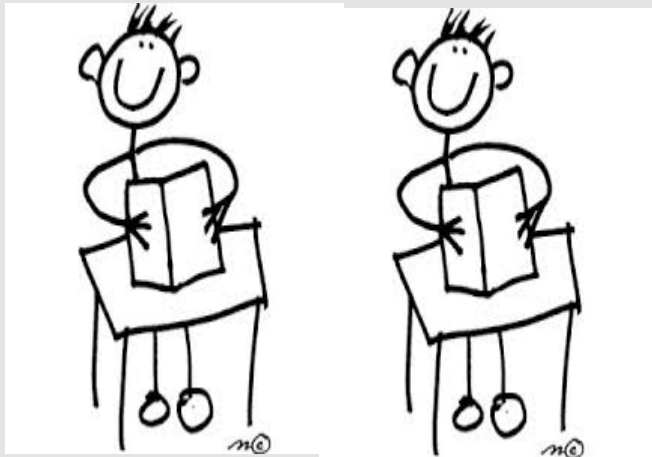
Idea or Comment

Revoice

More Detail



Me



Another change to the conversation...

Asking students to revoice:

Asking students to restate, rephrase, or expand on a student contribution.

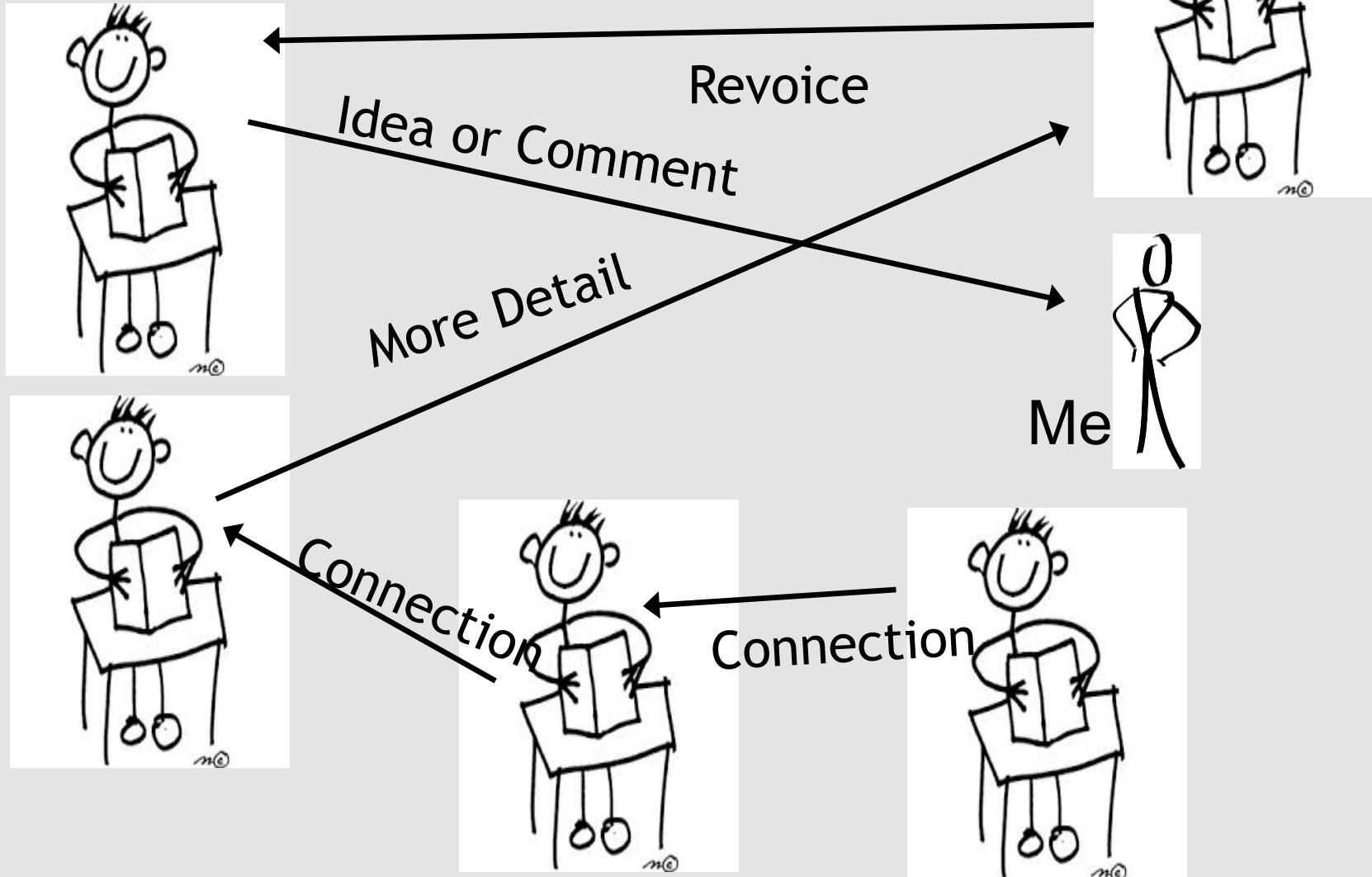
Remember that last student comment?

Student: When you add a pound, the price goes up two dollars instead of one-fifty, so the points will be higher and the line will go up faster, because the unit price is higher.

Me: Can someone else put that in their own words?

Student B: With a higher price per pound, and it depends a lot that the price is on the y-axis, it's going to be steeper the higher the unit price.

Things start to look like this...



What's the impact?

- Engagement
- Active Listening
- Students making sense of ideas
- Entire class hears multiple ways of knowing
- Hear how kids are processing, not parroting
- Connections to background knowledge
- Opportunity to help kids reposition themselves in relation to each other and mathematics
- Increased understanding, on both local and standardized assessment

One last example...

Here's the problem: $-500 -^{-}150 = -350$
(in a Jeopardy context)

Here are the responses, with only minimal prompting from me...

“Taking away a negative gives a better score.”

“Subtracting a negative means the result will be greater than where you started.”

“If you had 500 red chips, and took away 150 red chips, there would still be 350 red chips.”

“Subtracting -150 points will increase their score because it moves them closer to zero.”

“This increased because subtracting a negative is the same as adding a positive.”

“This increases because it's making you take away negatives, so it leaves more positives.”

Evelynne Pyne

7th grade mathematics

Using Writing to *Create*
Opportunities to Engage with
Another's Reasoning

A decorative graphic consisting of a solid teal horizontal bar at the top, followed by a white horizontal bar, and then three thin, parallel teal horizontal lines on the right side of the white bar.

Why writing in math?

How does this help improve MATH learning?

Standards for Mathematical Practices:

- CCSS.MATH.PRACTICE.MP₃

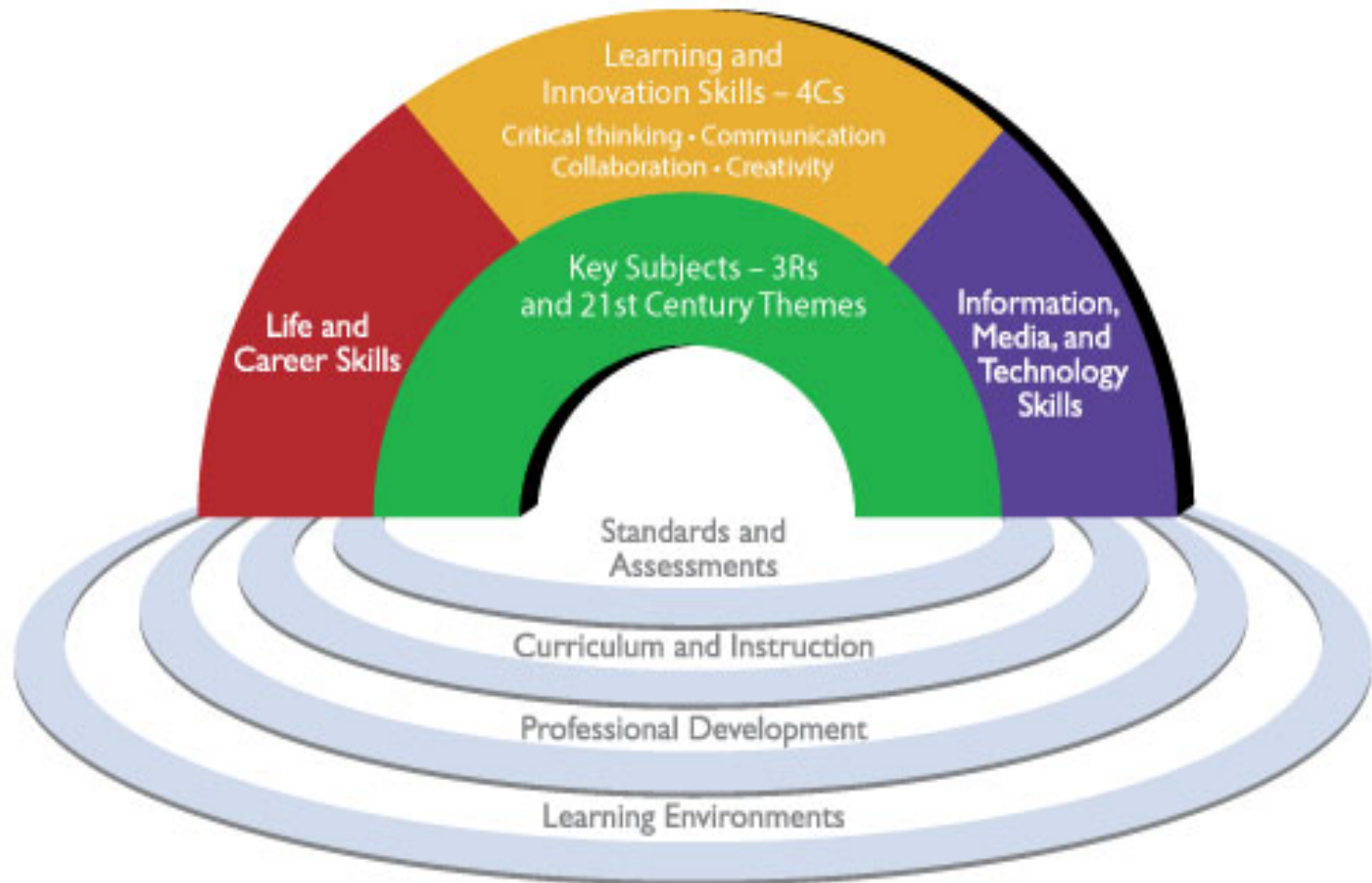
Construct viable arguments and critique the reasoning of others.

- CCSS.MATH.PRACTICE.MP₅

Use appropriate tools strategically.

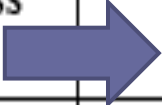
P21 Framework for 21st Century Learning

21st Century Student Outcomes and Support Systems



The Language Spectrum

CC1: Working in a small group	CC2: Reporting out to the whole class	CC3: Student writes a solution	CC4: Written description in a mathematics textbook
Text 1: Language of interaction	Text 2: Language of recounting experience	Text 3: Language of generalizing	Text 4: Mathematics register



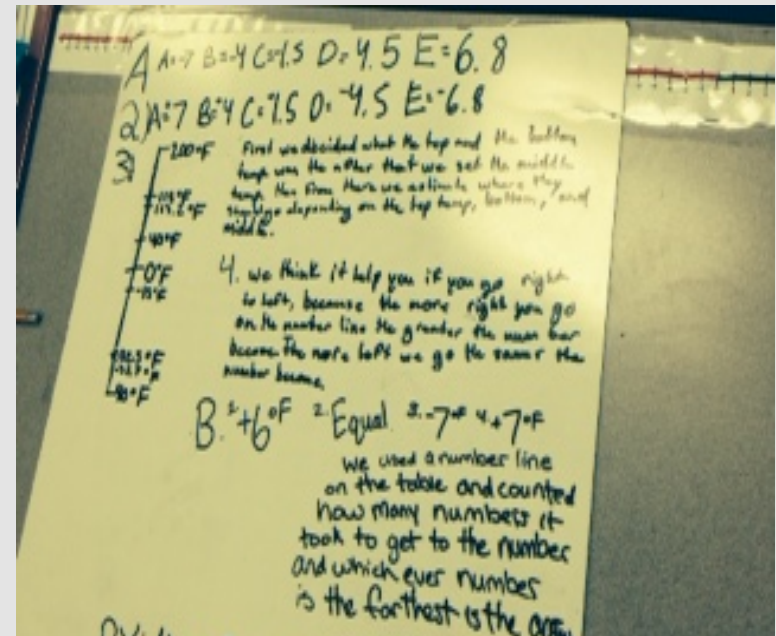
Creating Opportunities for Students to Engage in Another's Reasoning

Without planning, finding ways to ask students to engage with another's reasoning was challenging. I needed to plan for it.

Here are some strategies I started using in my classroom.

2ft. x 2ft. Whiteboards with Partners

- Allow students to work together
- Allow students to easily edit their answers
- Formative assessment throughout the activity/class
- Feedback for teacher
- Allows all students to see the responses of another student by just holding up the board



Creating Opportunities for Students to Engage in Another's Reasoning

- Before teaching the lesson, decide what methods you think students might use for the problem. Then, choose which methods you think would be most beneficial for your students.
- During work time, give a group some big hints to share out and let them know you will be calling on them.



Creating Opportunities for Students to Engage in Another's Reasoning

- Pass and write (chalk talk activity)

Choose one box to fill. Then wait patiently and pass when directed by the teacher.

$-13 + 18 = \underline{+5}$	
<p>Math Fever</p> <p>The 1st team has -13 because they got the first answer they had they got wrong but the next question they got</p>	<p>Algorithm</p> <p>They added negative to positive</p>
<p>Number line</p> <p>right</p> <p>The diagram shows a horizontal number line with an arrow pointing to the right. A tick mark is labeled -13. An arc starts at -13 and extends to the right, with a label +18 above it. The arc ends at a tick mark labeled +5.</p>	<p>Temperature</p> <p>So it was -13°F but there was a little wave of heat so it rose 18°F and now it is +5°F.</p>
<p>Integer Chips</p> <p>The diagram shows 13 negative chips (circles with an 'X') on the left, followed by a plus sign and 18 positive chips (solid circles) in the middle. An equals sign follows, and then 5 positive chips on the right. A box is drawn around the 5 positive chips.</p>	<p>Money</p> <p>So you owe someone 13 dollars, but then you get 18 dollars knowing the lawn so you can pay them back.</p>
<p>Fact Family</p> $-13 + 18 = +5$	<p>Adding/Subtracting the Opposite</p> $-13 - -18 = +5$

Creating Opportunities for Students to Engage in Another's Reasoning

Prompt: What strategy do you think is the easiest for this type of problem? Why? ($-18 - 13 = -31$)

Student 1: I think The number line because i
can see when The numbers go UP and down
and what The numbers are inbetween.

Student 2: I agree with Student 1. I believe that the
numberline is the best and most practical way
because you can clearly see the numbers go up
and down.

Creating Opportunities for Students to Engage in Another's Reasoning

- Take a picture of a student example from the previous day and use it as part of the warm-up to launch thinking and discussion.

Creating Opportunities for Students to Engage in Another's Reasoning

- Give them some “student” work and have them discuss the method and/or the clarity of explanation.
- Then, use that method to solve a similar problem.

2) What did the explanation do well?

3) How could the explanation be improved?

4) Compare this method with your own. How is it similar? How is it different?

Impact...

- More students justify their thinking in writing, which prepares them for higher level mathematics
- Analyze and critic another students' reasoning



Leah Jones

8th grade mathematics

Data Collection

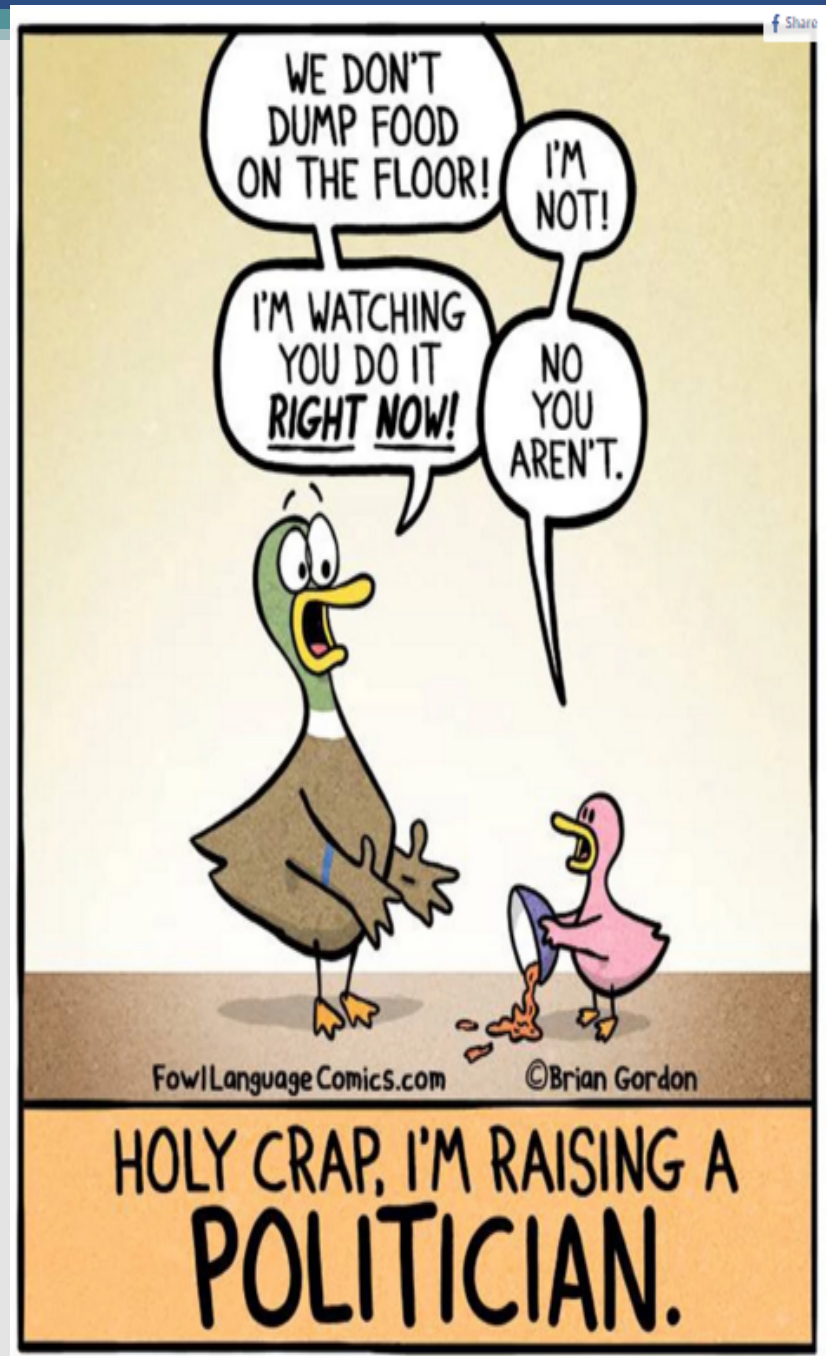
A Sample Collection Tool I Use
Real Data from My Classroom

Data Collection :

Can I Make the Claim that DISCOURSE is Working In My Classroom?

(Because what *you feel* is happening in your classroom, may or may not be what is *really* happening in your classroom.)

Videotape your teaching!



A Simple Attendance Grid - Modified

- I collect data from both sources: Student and Teacher.
- I look for myself using the DISCOURSE moves.
- I look at my students to see how they respond.

Student Data				Teacher Data			
GENERAL RESPONSE	EXPLAINED THINKING	RESPOND TO ONE ANOTHER'S	REVOICE EACH OTHER	FUEL	REVOICE	PROBE	WAIT

Some data I collected from watching videos of my classroom.

What Claims Can I Make?

- Using the TDMs (Teacher Discourse Moves)
 - Probing
 - Revoicing
 - Wait Time
 - Think. Plan with Partner. Be ready to respond.
- Whole-Group Discussion
 - Who is participating?
 - How are they discussing?
 - Explaining their thinking
 - Responding to the thinking of others.

These Are My Claims

- I have changed how I teach and how I think about teaching.
- My students have changed how they learn, how they think about learning, and how they see themselves as learners.
- **Most importantly**, my students are *communicating their understanding* in productive and powerful ways during our classroom discussion.

Jodi Wheeler

High school mathematics teacher
(former Middle School Coach)

Characteristics of Our Community

- Structured professional development
 - Study Group
 - Action Research
- Commitment to gathering data
- Time
 - Analyze data
 - Discuss data
- Constant conversations surrounding discourse
 - Making sense of ideas in context of practice
 - Feeling comfortable celebrating successes and sharing obstacles
 - Providing the opportunity to problem solve, question, and brainstorm together
- Support
 - District
 - Building-Level
 - Facilitator

Community Moving Forward

- Creating a culture related to productive and powerful discourse
 - Teachers, Students, Parents, Community
- Awareness outside immediate community
 - Students: ongoing work, instructional changes, classroom expectations
 - Teachers: high school teachers commenting on how students are participating
 - District: 5th grade teacher interest in discourse work
- Bridging the gap
 - Vertical consistency
 - Expanding the community (consistent, productive, and powerful)

Thank you! Questions? Comments?
Reflections?

For more information go to
www.mdisc.org

Acknowledgments

- Michelle Cirillo (U-Delaware) & Mike Steele (UW-Milwaukee), co-PIs
- Dave Wagner (U-New Brunswick)
- Teacher-researchers from Iowa
 - Tammie Cass, Darin Dowling, Patty Gronewold, Jean Krusi, Lana Lyddon Hatten, Jeff Marks, Joe Obrycki, Angie Shindelar
- Facilitators & teachers who piloted the MDISC materials
- Project teams
 - Current MDISC: Frances Harper
 - Past: Jillian Cavanna, Kate Johnson, Kathleen McAneny, Samuel Otten, Heejoo Suh, Alexandria Theakston, Shannon Sweeny, Dan Clark, Heather Bosman, Faith Muirhead, Lorraine Males, Jen Nimtz, & Rachael Todd, Katie Skowronski, Lee Gatens; Ryan Jwanoukos, Ahn Nguyen, Rachel Goeb
- Advisory Board members
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- Lisa Jilk (U-Washington), Consultant
- National Science Foundation

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the MDISC group and do not necessarily reflect the views of the National Science Foundation