The state of mathematics education in America

Where are we after a decade of High Stakes Accountability?

WYTIWYG
What You Test Is What You Get!
The Achievement Gap

<table>
<thead>
<tr>
<th>NAEP 2009</th>
<th>US 4th Grade</th>
<th>US 8th Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Students</td>
<td>248</td>
<td>292</td>
</tr>
<tr>
<td>Black</td>
<td>222</td>
<td>260</td>
</tr>
<tr>
<td>White</td>
<td>208</td>
<td>292</td>
</tr>
<tr>
<td>Hispanic</td>
<td>227</td>
<td>265</td>
</tr>
<tr>
<td>Asian</td>
<td>255</td>
<td>300</td>
</tr>
<tr>
<td>Low Income</td>
<td>272</td>
<td>260</td>
</tr>
<tr>
<td>Mid-High Income</td>
<td>250</td>
<td>293</td>
</tr>
<tr>
<td>English Learner</td>
<td>210</td>
<td>243</td>
</tr>
<tr>
<td>English Fluent</td>
<td>242</td>
<td>284</td>
</tr>
</tbody>
</table>


Source: U.S. Department of Education

Approximately 10 scale points is equivalent to a grade level of learning

NY TIMES April 29, 2009
Persistent Racial Gap Seen in Students Test Scores
By SAM DILLON

The achievement gap between white and minority students has not narrowed in recent years, despite the focus of the No Child Left Behind law on improving black and Hispanic scores, according to results of a federal test considered to be the nation’s best measure of long-term trends in math and reading proficiency.
NAEP 2009 Results by Economic Status

Approximately 10 scale points is equivalent to a grade level of learning.

NAEP 2009 Math - Language Fluency

Approximately 10 scale points is equivalent to a grade level of learning.

NAEP 2009 8th grade

National Ave. 282
Massachusetts (1st) 299
California (49th) 270

Where you live and your background correlates to how you score on tests.
Link Assessment and Learning

“Assessment should be an integral part of teaching. It is the mechanism whereby teachers can learn how students think about mathematics as well as what students are able to accomplish.”

Everybody Counts

A New Direction in Assessment

Common Core State Standards Initiative

The Common Core State Standards Initiative is a joint effort by the National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO) in partnership with Achieve, ACT and the College Board. Governors and state commissioners of education from across the country committed to joining a state-led process to develop a common core of state standards in English-language arts and mathematics for grades K-12. These standards will be research and evidence-based, internationally benchmarked, aligned with college and work expectations and include rigorous content and skills. The NGA Center and CCSSO are coordinating the process to develop these standards and have created an expert validation committee to provide an independent review of the common core state standards, as well as the grade-by-grade standards. The college and career ready standards are expected to be publicly released in September 2009. The grade-by-grade standards work is expected to be completed in December 2009.
Number. Procedural fluency in operations with real numbers and strategic competence in approximation are grounded in an understanding of place value. The rules of arithmetic govern operations and are the foundation of algebra.

Expressions. Expressions use symbols and efficient notational conventions about order of operations, fractions, and exponents to express verbal descriptions of computations in a compact form.

Equations. An equation is a statement that two expressions are equal, which may result from expressing the same quantity in two different ways, or from asking when two different quantities have the same value. Solving an equation means finding the values of the variables in it that make it true.

Functions. Functions describe the dependence of one quantity on another. For example, the return on an investment is a function of the interest rate. Because nature and society are full of dependencies, functions are important tools in the construction of mathematical models.

Quantity. A quantity is an attribute of an object or phenomenon that can be measured using numbers. Specifying a quantity pairs a number with a unit of measure, such as 2.7 centimeters, 42 questions, or 28 miles per gallon.

Modeling. Modeling uses mathematics to help us make sense of the real world—to understand quantitative relationships, make predictions, and propose solutions.

Shape. Shapes, their attributes, and the relations among them can be analyzed and generalized using the deductive method first developed by Euclid, generating a rich body of theorems from a few axioms.

Coordinates. Applying a coordinate system to Euclidean space connects algebra and geometry, resulting in powerful methods of analysis and problem solving.

Probability. Probability assesses the likelihood of an event. It allows for the quantification of uncertainty, describing the degree of certainty that an event will happen as a number from 0 through 1.

Statistics. We often base decisions or predictions on data. The decisions or predictions would be easy to make if the data always sent a clear signal, but the signal is usually obscured by noise. Statistical analysis aims to account for both the signal and the noise, allowing decisions to be as well informed as possible.

Clearer, Fewer and Higher

Race to the Top

Goals of Assessment

“We must ensure that tests measure what is of value, not just what is easy to test. If we want students to investigate, explore, and discover, assessment must not measure just mimicry mathematics.”

Everybody Counts
Performance Assessments
To Inform Instruction And Measure Higher Level Thinking

Task Design

- The Mathematics Assessment Resource Service (MARS) is an NSF funded collaboration between U.C. Berkeley and the Shell Centre in Nottingham, England.
- The Assessments target grades 2-6 and are aligned with the State and NCTM National Math Standards.

2009 Comparison Between CST & MARS

<table>
<thead>
<tr>
<th>Grade</th>
<th>CST Prof &amp; CST Prof</th>
<th>MARS 1</th>
<th>MARS 2</th>
<th>MARS 3</th>
<th>MARS 4</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>Far Below</td>
<td>3%</td>
<td>9%</td>
<td>0%</td>
<td>0%</td>
<td>4%</td>
<td>7%</td>
</tr>
<tr>
<td>Below</td>
<td>1%</td>
<td>4%</td>
<td>1%</td>
<td>0%</td>
<td>1%</td>
<td>5%</td>
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<tr>
<td>Basic</td>
<td>43%</td>
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<td>0%</td>
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<tr>
<td>Proficient</td>
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<td>7%</td>
<td>13%</td>
<td>12%</td>
<td>25%</td>
<td>19%</td>
</tr>
<tr>
<td>Advanced</td>
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<td>8%</td>
<td>26%</td>
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<tr>
<td>Totals</td>
<td>17%</td>
<td>33%</td>
<td>28%</td>
<td>33%</td>
<td>100%</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Grade</th>
<th>CST Bas &amp; CST Bas</th>
<th>MARS vStd</th>
<th>MARS v Std</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>CST Bas &amp; CST Bas</td>
<td>28%</td>
<td>53%</td>
<td>53%</td>
<td>100%</td>
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<tr>
<td>CST Prof &amp; CST Prof</td>
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<td>100%</td>
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<tr>
<td>Totals</td>
<td>40%</td>
<td>59%</td>
<td>100%</td>
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### Trends Grade to Grade

<table>
<thead>
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<th>Grade 1</th>
<th>MARS Yield</th>
<th>MARS* STR</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>CST Prof</td>
<td>40.3%</td>
<td>81.3%</td>
<td>100%</td>
</tr>
<tr>
<td>CST Basic</td>
<td>60.3%</td>
<td>64.9%</td>
<td>100.1%</td>
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<tr>
<td>Total</td>
<td>50.3%</td>
<td>81.2%</td>
<td>100%</td>
</tr>
</tbody>
</table>

40 states have signed on to develop performance assessment for state accountability in a RttT education consortium.

- **Linda Darling Hammond**

- **Bill & Melinda Gates Foundation**

### Formative Assessment
Looking at Student Work

The process of studying student work is a meaningful and challenging way to be data-driven, to reflect critically on our instructional practices, and to identify the research we might study to help us think more deeply and carefully about the challenges our students provide us. Rich, complex work samples show us how students are thinking, the fullness of their factual knowledge, the connections they are making. Talking about them together in an accountable way helps us to learn how to adjust instruction to meet the needs of our students.

Annenberg Institute of School Reform

Educational Research:
Formative Assessment and Student Work to Inform Instruction

- Assessing Student Outcomes; Marzano, Pickering, McTighe
- Inside the Black Box; Black, Williams
- Understanding by Design; Wiggins, McTighe
- Results Now; Schmoker
- Professional Learning Communities at Work; Dufour, Eaker
- Accountability for Learning; Reeves
- Math Talk Learning Community; Fuson, et al
- Normalizing Problems of Practice; Little, Horn
- Change the Terms for Teacher Learning; Fullan
- Working toward a continuum of professional development; Loucks-Horsley, et al.

Assessment

Summative
- Assessments to Rank, Certify, or Grade.
  - High-Stakes Tests
  - State Tests
  - HS Exit Exams
  - SAT, ACT
  - Norm-Reference Final Exams

Formative
- Performance Assessments
  - Tests
  - Quizzes
  - Assignments
  - To inform instruction

Formative meaning during instruction to inform instruction

Assessments to Rank, Certify, or Grade.
- Unit/Chapter Tests
- Semester/Quarter Tests
- Computer-based exams
- Benchmark Tests

Students' comments, explanations, questions, and/or work in class.
Inside the Black Box
by Paul Black and Dylan Wiliam, Phi Delta Kappan, copyright 1998

Follow up research:
Working Inside the Black Box

Formative Assessment is:
Students and teachers
Using evidence of learning
To adapt teaching and learning
To meet immediate learning needs
Minute-to-minute and day to day

Dylan Wiliam, University of London

Educational Interventions

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Extra months of learning per year</th>
<th>Classroom cost per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class-size reduction (from 20 to 30)</td>
<td>3</td>
<td>$30,000</td>
</tr>
<tr>
<td>Increase teacher content knowledge (2 sd)</td>
<td>1.5</td>
<td>Unknown</td>
</tr>
<tr>
<td>Formative Assessment</td>
<td>6 to 9</td>
<td>$3,000</td>
</tr>
</tbody>
</table>
Effective Formative Assessment Strategies

- Clarifying learning intentions and sharing criteria for success
- Engineering effective classroom discussions.
- Providing feedback that moves learners forward.
- Activating students as the owners of their own learning.
- Activating students as instructional resources for one another.

Dylan Wiliam, University of London

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The Results from an Assessment

Students’ performances are across the continuum
Traditionally Teachers Choose One of Three Options

- Go back and re-teach the topic with the entire class.
- Identify the students needing remediation and find some time/opportunity to re-teach the topic while the rest of the class continues on.
- Feeling the pressure of the over packed curriculum the teacher ventures on to the next topic.

Re-engagement: Completing the Formative Assessment Cycle

- Administer Tasks
- Examine Student Work
- Inform Teacher Knowledge
- Inform Instruction
- Re-engagement Lessons

Common Core Standards

MARS Tasks

Tools for Teachers and PD Materials

Scoring and Student Work Protocols
The MAC/MARS Math Performance Assessments

- The Mathematics Assessment Resource Service (MARS) is an NSF funded collaboration between U.C. Berkeley, Michigan State and the Shell Centre in Nottingham England.
- The Assessments target grades 2- Geometry and are aligned with the State and NCTM National Math Standards.

**Task Design**

**Entry level** - (access into task)

**Core Mathematics** - (meeting standards)

**Top of the Ramp** - (conceptually deeper)

**Ramp**

**Core**

**Top**

**Access**

**Sample Task**

**Candies**

The problem gives you the chance to work with fractions and ratios.

1. This is Amy’s box of candies. We first estimate the area of each.
   - What fraction of the candies has any chocolate?

2. Vivian shares some of the 12 candies from this box. We are trying to study the number of candies she can take.
   - How many candies does Vivian take?
   - How many candies does she give to Candy?

3. In another group of 1000 candies, there are 30 candies for every 3 candies. There are 36 candies in this box.
   - How many candies can I take?
   - How many candies can I give away?

**Authentic Candy Recipe**

1. For 1 hour, I cook 3 cups of cocoa with 2 cups of chocolate.
   - Is it 3 cups of cocoa or 2 cups of chocolate?
   - How many more cups of sugar than 3 cups of cocoa?

2. Replace how you figured this out.
Designing Re-engagement

The Mathematics Assessment Collaborative uses a process of formative assessment that uses student work and assessment results to inform instruction and design lessons to re-engage students in learning the mathematics.

Opening- Setting the Stage

Give student “think” sheets.
“Today we are going to look at the Candies task and different ways student solved the problems.”

Goals:
• Examine how others solved the problems
• Discuss like mathematicians why the approach makes sense
• Listen to see if you hear something that makes you change your mind
Opening question: 6/9
Where’s the 6? Where’s the 9?

1. This is Amy’s box of candies. She has already eaten 6 of them.

What fraction of the candies has Amy eaten?

Another student put 2/3? Could that be correct?

Where do you see the 2? The 3?

Take a minute to think through how a student might answer these questions.

Small Group Discussions

How was the re-engagement activity designed to provide access?
What were the basic concepts the students needed to learn and understand?
What did the students communicate?
What did the teachers emphasize?
Valerie shares some of the 12 candies. She gives Cindy 1 candy for every 3 candies she eats herself. How many does she give Cindy?

What is the top student thinking? Think, pair, share.

I want to share this problem with a class. Which one is more clear? Why?

Small Group Discussions

How were students' representations used to promote understanding of the mathematics of the task?

What do you think was the teacher's purpose in sharing the student work?

Describe evidence of students being instruction resources for one another.
New Recipe

Anthony makes candies.
First, he mixes 1 cup of cream with 2 cups of chocolate.
In all, he uses 9 cups of these 2 ingredients.
How many cups of chocolate does he use in this recipe?

Confronting misconceptions:

Students confronted with misconception. Students asked, “What do you think the student was thinking?” Then: “How could the student use this drawing to get the correct solution?”
Small Group Discussions

How was the student's work used to deepen the understanding of the core mathematical concepts?
Describe the components of the activity that supported students to work at high cognitive levels?
What did the teachers do to facilitate deeper student thinking?

Providing Challenge

Some Reasons for Using Re-engagement

• Clarify an idea
• Compare strategies and explain why they work
• Make generalizations about types of problems (move away from specific answers to strategies for types of problems)
Some Reasons for Using Re-engagement

- Confronting misconceptions to understand the error in the logic
- Provides immediate specific feedback on student work
- Model qualities or characteristics of desired performance

Bell and Swan study

Re-teaching vs. Re-engagement

- Teach the unit again
- Address basic skills that are that are missing.
- Do the same or similar problems over.
- Practice more to make sure student learn the procedures.
- Focus mostly on underachievers.
- Cognitive level are usually lower.

- Revisit student thinking.
- Address conceptual understanding.
- Examine task from different perspective.
- Critique student approaches/solutions to make connections.
- The entire class is engaged in the math.
- Cognitive level are usually higher.
Prepare to Design a Re-engagement

- Do the task and consider the math
- Consider how the students might approach the math, where and how would they be successful, what challenges or misconception may arise?
- Look through the student work. Categorize solution strategies, approaches and where students struggled. What is the story of the task?
- Use the Tools for Teachers to compare your findings with the history of the tasks.

What is the mathematical story of this task?

- What are the big mathematical ideas in the task?
- What are the themes that emerge from the student work?
- What might be underlying causes for problems?
Tools for Teachers
Linking Assessment and Learning

"Assessment should be an integral part of teaching. It is the mechanism whereby teachers can learn how students think about mathematics as well as what students are able to accomplish."

Everybody Counts

5th grade  | Task 3  | Buttons
---|---|---
Student Task | Use a letter arrangement pattern to describe, extend, and make generalizations about its numeric pattern.
Core Idea 3 | Understand patterns and use mathematical models such as algebraic symbols and graphs to represent and understand quantitative relationships.
Patterns and Functions | Discuss and extend numeric patterns (4th grade).
 | Represent and analyze patterns and functions using words (5th grade).
 | Investigate how a change in one variable relates to a change in a second variable.

Based on teacher observations, this is what fifth grade students know and are able to do:
- Contains a pattern using pictures and numbers.
- Explains how a pattern grows and use that algorithm to solve for larger numbers in the pattern.

Areas of difficulty for fifth grade, fifth grade students struggled with:
- Distinguishing between part of a pattern and the whole pattern.
- Explaining a pattern in words.

70% were unable to explain how to find pattern 11.
Questions for Reflection on Buttons:
- What are some rich problems that your students have done this year? What are some good sources for pixel problems?
- Do you ask questions like: "What's the same?" and "What's different?" to help students develop the ability to form generalizations?
- Do students have opportunities to connect their number sentences to geometric patterns and share how they visualize the growth pattern?

<table>
<thead>
<tr>
<th>Show a picture</th>
<th>24 x 3 or 24+24+24</th>
<th>24 x 3 or 24+24+24+1</th>
<th>Extract a table</th>
<th>Repeated addition of 3</th>
<th>Used a drawing from a previous part of the problem</th>
</tr>
</thead>
</table>

Teacher Notes:

Looking at Student Work - Buttons:
Many students at grade level are able to see the pattern and form a generalization for the growth in number of objects. These generalizations could easily be associated to algebraic symbols at later grade levels. Student A has a clear description of how the pattern grows in an algorithmic form for the total number of buttons in part 6.

Pattern 1: 1 bubble
Pattern 2: 6 bubbles
Pattern 3: 11 bubbles
Pattern 4: 16 bubbles

1. Draw Pattern 4 next to Pattern 1.
2. How many more buttons does Gia need for Pattern 3 and Pattern 4?
Pattern 3: 5 bubbles
Pattern 4: 11 bubbles

Explain how you figured this out:
For each pattern, there is the same number of objects. But for Pattern 4, the number of buttons is one more than the number of bubbles.
5. How many buttons all does Gia need for each symbol? Mark T

Explain how you figured this out:
I did the same process as the previous column. I added 1 to the answer for each symbol.

Student A, part 1:
6. How many buttons are needed to make Pattern 24?

How do you know this is correct?
Because I know the pattern for multiplying 6 by 6, I can see the pattern of adding 6 repeated 12 times. The total number of bubbles is 72 bars.

How many buttons does she need to make Pattern 24? 75 bars

For further examples of making generalizations and algorithms, look at the work of Student B below.

Student B:

How do you know the sum is correct?

How many buttons does she need to make Pattern 24? 75 bars

\[ \frac{94}{94} + 1 = 95 \]
Cycle of Formative Assessment to Inform and Improve Learning

Administer high-quality assessment tasks
Collectively score and analyze student work
Document student thinking in relation to instruction

Leads to improved teaching and learning in the classroom (re-engagement)
Drives the professional development experiences of the teachers to plan experiences focused on their students.
Opportunity to Analyze Student Work

Analyzing Student Work
In each group:
1. Do the task
2. From your student work complete MARS Analyzer (line plot and measures of center)
3. Flag interesting Work - unusual strategy, common misconceptions, good answer or "what were they thinking????"
4. Discuss in group and complete Score Analysis Chart
5. Complete the MARS Task Analysis Sheet

Re-Engagement Protocol

Initial Activity

Describe the "Story of the Task"
Determine the student work. What important mathematical ideas surfaced in the initial lesson and in student work?

Pick a few key examples from student work
They might represent common strategies, novel approaches, misconceptions, or lead to contradictory answers.

Design a Re-Engagement prompt
Use excerpts from the examples of student work to formulate questions to re-engage all students in the mathematics of the task.
The design of a MARS task

Top

Core

Ramp

Access

Viewing a Re-engagement Lessons

Examine Learner A's Work

Learner A

3. How many buttons in all does Gita need to make Pattern 11? 34 Buttons

Explain how you figured this out.

I x (11 x 3) + 1 = 34 buttons
I added one for the black button in the middle

How is Learner A making sense of the mathematics?
Examine Learner B’s Work

Learner B

3. How many buttons in all does Gita need to make Pattern 11?

34

Explain how you figured this out.

I added $4 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 = 34$ which is the # of buttons.

How is Learner B making sense of the mathematics?

Small Group Discussions

How was the re-engagement lesson designed to provide access, address the core, and create high cognitive demands?

How were the students making sense of the mathematics?

How did re-engagement promote student discourse?

Describe important teacher moves that facilitated the discourse.
Re-engagement

- Makes use of actual student work - including unique thinking, misconceptions and strategies.
- Has all students re-work a task from different perspectives.
- Confronts misconceptions, so that they can be dealt with and let go.
- Gives some students strategies for solving problem
- Helps other students solidify, connect, and clarify their ideas.

Effective Formative Assessment Strategies

- Clarifying learning intentions and sharing criteria for success
- Engineering effective classroom discussions.
- Providing feedback that moves learners forward.
- Activating students as the owners of their own learning.
- Activating students as instructional resources for one another.

Dylan Wiliam, University of London

Pizza Crusts

This problem gives you the chance to:
- Find areas and perimeters of rectangular and circular shapes in a practical context.

1. How many inches of stuffed crust are put around the edge of each of these pieces?

A __________ inches  B __________ inches  C __________ inches
2. Draw a square piece with an area of 36 square inches. 
   a. What length of ribbon can be wound around the edge?
      _______ inches

3. Design two rectangular pieces, each with an area of 36 square inches, with different perimeters, so that Bob will have more area than on the square piece. 
   a. What is the perimeter of the rectangular pieces?
      _______ inches

   b. Explain how you figured this out.

---

**Pizza Crusts**

<table>
<thead>
<tr>
<th>Points</th>
<th>Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>The correct answers are: 1) 5 inches, 2) 7 inches, 3) 6 inches.</td>
</tr>
<tr>
<td>4</td>
<td>The correct answers are: 1) 5 inches, 2) 7 inches, 3) 6 inches.</td>
</tr>
<tr>
<td>2</td>
<td>The correct answers are: 1) 5 inches, 2) 7 inches, 3) 6 inches.</td>
</tr>
</tbody>
</table>

---

**Tools for Teachers**
7th Grade Pizza Crust 2006

The minimum score available for this task is 6 points.
The minimum score for a level 3 response, meeting standards, is 4 points.

7th Grade – Task 3: Pizza Crusts
Work the task and examine the rubric.
What do you think are the key mathematics the task is trying to assess?

Look at student work in part 1a and 1b. How many of your students are confusing area and perimeter?
Now look at student work for 2a.
• How many of your students confused 36 sq. in. for the perimeter instead of the area? What would their answer have been?
• How many of your students put the length of one edge instead of the total length of the crust?

Look at the work for designing a rectangle.
• How many of your students gave dimensions that would yield an area different than 36 sq. inches?
• How many of your students gave dimensions that would yield a perimeter of 36 inches?
• How many of your students gave dimensions that would not create a rectangle?
• What other types of errors did you find?

Student G makes the common error of confusing area and perimeter in part 2a.

2. Here is a square pizza with an area of 36 square inches.
(a) What length of stuffed crust will be around the edge?

Student H draws in the units to find the perimeter in part 2b. However, for both rectangles the area is 32 sq. in. instead of 36 square in.
Student J treats all geometric shapes as squares for finding the perimeter. The thinking stays consistent even in part 3. What does it take to help shake a student from a misconception? Notice that the student confuses area and perimeter in part 2b and just gives a perimeter of 36 in, with no dimensions.

Student K tries to find the area of all the pizzas in part 1 instead of the perimeter. In part 2a the student finds the length of one edge instead of the total length of the edge. But in part 2b the student is successful at finding the dimensions of two rectangles with same areas and different perimeters.
Viewing a Re-engagement Lessons

The Mathematics Assessment Collaborative uses a process of formative assessment that use student work and assessment results to inform instruction and design lesson to re-engage students in learning the mathematics.

Re-engagement Happens “Live”

- The heart of the process is in the discussion, controversy, and convincing of the big mathematical ideas.
- This is where students have the opportunity to clarify their own thinking, confront their misconceptions to see the errors in logic, use mathematical vocabulary for a purpose, and make generalizations and connections.

Re-engagement

- Has all students re-work task from different perspectives.
- Confronts misconceptions, so that they can be dealt with and let go.
- Gives some students strategies for solving problem
- Helps other students solidify and clarify their ideas.
Re-engagement

- Use student work and their thinking to surface understanding and misconceptions.
- Use student work to address access into basic concepts and foundational understanding.

Scoring and Analyzing the Student Assessment Papers

- Collectively score student work
- Sort student work by score (beginning, middle, end)
- Share analysis and begin thinking about re-engagement
- Complete analysis of student work and teaching implications
- Create a chart of Understandings and Misunderstandings (similar to TFT)
- Go over the Task and Rubric with T&S Papers
- Collectively score student work
- Sort student work by score (beginning, middle, end)
- Share analysis and begin thinking about re-engagement
- Complete analysis of student work and teaching implications
- Create a chart of Understandings and Misunderstandings (similar to TFT)
Small Group Discussions

What is the core mathematics of the task?
What experiences in the lesson focused learning around the core mathematics?
How was student work used to promote understanding of the core mathematics?
Describe evidence of students demonstrating that understanding. Where are students still struggling?

Re-engagement

- Use student work to confront common misconceptions.
- Use student work to apply or adapt new or unfamiliar strategies.
- Use student work to “debug” unsuccessful approaches or flawed reasoning.

In order to learn core concepts
Small Group Discussions

Describe the components of the lesson that supported students to work at high cognitive levels?

What aspects of the lessons encouraged students to make connections?

How did students demonstrate deeper understanding of the mathematical concepts?

What did the teachers do to facilitate deeper student thinking?

Re-engagement

• Use student work to critique other students' solutions and processes in order to deepen understanding and ramp up the cognitive load of the task.
Some of the Purpose of Re-engagement

Re-engagement lessons may:
• Make use of actual student work - including unique thinking, misconceptions and strategies.
• Have all students re-work a task from different perspectives.
• Confront misconceptions, so that they can be dealt with and let go.
• Give some students strategies for solving problem
• Help other students solidify, connect, and clarify their ideas.
• Allow students to critique solutions and processes in order to deepen understanding and raise the cognitive load of the task.
**Re-engagement Protocol**

- Initial Activity

  1. Describe the "Story of the Task"
  2. Pick a few key examples from student work
  3. Design a Re-engagement prompt

**Design a Re-engagement Lesson**

- What are the foundational concepts that need to be solidified?
- What examples of student work or errors could be presented?
- What approaches or strategies are unique or present a reasoning dilemma? What student work might be shared?
- What conceptual ideas do you want students to learn or connect? What student work would engage the students and invite high cognition.

**Re-engagement Happens “Live”**

- The heart of the process is in the discussion, controversy, and convincing of the big mathematical ideas.
- This is where students have the opportunity to clarify their own thinking, confront their misconceptions to see the errors in logic, use mathematical vocabulary for a purpose, and make generalizations and connections.
Re-engagement

- Makes use of actual student work - including unique thinking, misconceptions and strategies.
- Has all students re-work a task from different perspectives.
- Confronts misconceptions, so that they can be dealt with and let go.
- Gives some students strategies for solving problem
- Helps other students solidify, connect, and clarify their ideas.

Small Group Discussions

How was the re-engagement lesson designed to provide access?
What were the basic concepts the students needed to learn and understand?
How were the students making sense of the mathematics?
What did the students communicate? What did the teachers emphasize?

Designing a Lesson

- What makes a good opening?
- What is important about this piece?
- How does it lay a foundation to bring all students along?
Re-engagement

- Give ourselves permission to spend more time on a problem and its discussion.
- Give students the opportunity to really examine the mathematics and change their ideas through rich dialogue.
- Promotes sense-making, justification, making conjectures and testing them.
- Ups the cognitive demand of the task.

Process of Re-engagement

- Give students a purpose for re-examining the work or mathematics of a task by creating a dilemma or cognitive conflict.
- Move students from the process of solving a problem to justification and sense-making. Why did this work? Why doesn’t this make sense? Involve them in the discipline of doing mathematics.

Welcome to the Inside Mathematics Website

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