If two wrongs don't make a right, try three.

— Laurence Peter
Can 3 wrongs make a right?
Helping Teachers and Coaches Use Assessment Items to Drive Students’ Thinking

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What is assessment?

- Voodoo
- Punishment
- The bane of my existence
- A sadistic plot
- A process of reasoning from evidence
- All of the above
- None of the above
Beliefs

- Assessment is a process of reasoning from evidence about student understanding.
- Assessment is an essential part of instruction.
- Teachers can learn from assessment.
- Students can learn from assessment too.
Let’s get ready: some questions

☐ How well do your *students* understand the purposes of assessment?

☐ How well do your *teachers* understand the purposes of assessment?

☐ How much time, effort, and resources does your organization spend on *assessing* students relative to instructional *responses* to that data?

☐ Are students *learning* much from assessment?
I: Some very brief foundations

- What is assessment for?
- ... and, who is assessment for?
- What makes assessment good?
- ... for what?
- How do we do it well?
- ... given our context and constraints?
Assessment is part of teaching
Understanding by Design

1. Identify Desired Results
2. Determine Acceptable Evidence
3. Plan Learning Instruction
The assessment triangle

- Cognition
- Observation
- Interpretation
What’s involved in the process?

- Someone decides what students should know
- Teachers select or create items
- Teachers sequence or create assessments
- Students work on assessments
- Hopefully, some understanding of the results
- Possibly, some related classroom activities
Some modest goals for the process

- Teachers learn from assessment, and...
  - What we learn is accurate.
  - What we learn is actionable.

- Students learn from assessment...
  - About our mathematical goals.
  - About their own understanding.

- Assessment does not detract from learning by...
  - Displacing more valuable learning activities.
  - Damaging student understanding or motivation.
What’s our role in the process?

- Better-defined objectives for learning are here
- Better large-scale assessments are coming
- Better instructional materials too, we hope

As mathematics leaders, we must learn how to help teachers use all of these — including large-scale and local assessment — to improve student learning.
An MC item stolen from Phil Daro

Why do students have to do math problems?

A. To get answers, because Homeland Security needs them — pronto!
B. I had to; so why shouldn’t they?
C. So they will listen to me in class…
D. To learn mathematics.
A goal for assessment items

Kids get the item right for the right reason, and wrong for the right reason.

The right reason is understanding of the objective.
A rectangle has length 3.7 cm and width 5.4 cm. What is its perimeter?

A. 8.1 cm  
B. 9.1 cm  
C. 16.2 cm  
D. 18.2 cm
Building a multiple-choice item

- Figure out what you’re trying to assess
- Make a task (stem or prompt) and answer it
- What misconceptions most concern you?
- Create distractors based on misconceptions
- Clean up your item and options
- Is it still aligned with the objective?
Building good classroom tests

- What makes a good test?
  - Teacher learns from the test
  - Student learns from the test
- Start with good items (as previously defined)
  - Note good items require defined learning goals
- Taking a test can be a learning experience
  - Tests can enhance learning more than other study
  - Mixed sets are more cognitively demanding
II: Can teachers learn from tests?

- What can teachers do with the results?
  - … on their own?
  - … with their colleagues?
  - … with their students?

- Do the results change anything?
  - Instruction?
  - Future assessment?
  - Something else?
You wrote a test. Now what?

- Presuming it was made of good items, how do teachers learn from the assessment results?

- Data gets meaning through comparison
  - Across students for one objective at one time
  - Across time for one objective for one student
  - Across objectives for one student at one time
**Across students: Item analysis**

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Across time: Proficiencies

Geometry – Fall Proficiencies

Student name:  
Year: 2006/7

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<th>Assessments</th>
<th>Angle Relationships</th>
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<th>Similarity</th>
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P+ means ‘Expert’
P means ‘Proficient’
NY means you are ‘Not Yet’ proficient
Meaning through comparison, cont’d

- Increasing the **scope** of comparisons
  - The power of common goals and/or assessments

- Combining **multiple dimensions**
  - More distilled learning goals make this easier

- Shifting the load onto **students**
Across domains: Test reflection

<table>
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<tr>
<th>Topic of the problem</th>
<th>Possible</th>
<th>Earned</th>
<th>Key Ideas for Problem</th>
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<tr>
<td>Evaluate composition of functions</td>
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<tr>
<td>Identify function from graphs</td>
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<td>Represent function as table from arrow diagram</td>
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<tr>
<td>Solve quadratic trigonometric equation</td>
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</table>

Your Total: out of 91

Which problems did the class have the most issues with? Which ones can you help with?

What topics should you review? What should you add to your summaries? What do you expect on the next test?
Products (and by-products)

- What do teachers learn...
  - About their students’ understanding?
  - About their items and assessments?
  - About their instructional practices?

- What do students learn...
  - About what they should be learning?
  - About the mathematical goals?
  - About reasoning from evidence?
Grading as a form of communication

- What do teachers’ grading practices (and products) tell them about student understanding or about instructional practice?

- What do teachers’ grading practices (and products) tell their students about their own understanding or about mathematical goals?
III: Promoting student thinking

- How can assessment items, and teachers’ practices and use of those items, promote student thinking?

- What are your ideas?
  - Affective, cognitive, or behavioral
  - Before, during, or after assessment
  - What are some common themes?
An interesting quote

- Students who have been able to explore why the wrong idea is wrong have a more secure and deeper understanding of why the right idea is right.

— Jonathan F. Osborne
Build foundational MC knowledge

- Build understanding of distractors as *errors linked to misconceptions* (not random choices)
- Build effective *critical reading*
  - Anticipating options
  - Using the information provided
- Grading for *work*, not just for the answer (also a way to give more feedback per minute)
Assessment and cognitive demand

- Items have various levels of cognitive demand
  - Low: Recall, recognition, perform procedure
  - Medium: Represent, multi-step, integrate, apply, solve a problem, compare, justify
  - High: Plan, analyze, judge, create, abstract, generalize, formulate a problem

- But solving an item is just one way to use it…
Assessment or learning activity?

- The cognitive demand of the task depends not only on the item, but also the activity we ask students to do with the item.

- (How) does this item make students think?
  - What kinds of items can do each?
  - What kinds of activities can do each?
Students can analyze items

- Given correct answers, justify or explain
- Explain the errors behind distractors
- Devise distractors and write rationales
- Can lead up to writing items, if scaffolded:
  - at the end of a unit
  - for prior learning topics (review)
  - in groups
  - for more “procedural” topics
Students can analyze performance

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<td>Evaluate composition of functions</td>
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<td>Solve quadratic trigonometric equation</td>
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<tr>
<td>3</td>
<td>Identify absolute value function from graph</td>
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</tbody>
</table>

Which problems did the class have the most issues with? Which ones can you help with?

What topics should you review? What should you add to your summaries? What do you expect on the next test?
Studying: From event to process

- Anticipating test content
- Reworking troublesome items
- Building the habits of revision and persistence
- The bottom line: Creating *agency* in students
Carol Dweck: The growth mindset

Students [with] a growth mindset… believe **their intelligence can be developed over time through their effort and learning**… [and] that everyone can learn and become smarter. [It] creates a framework in which students… see **effort as a good thing** and as a tool for learning and becoming smarter… that setbacks mean that they must… ramp up their effort and look for new study strategies.

Educators need to send a message that intelligence and talent are developed through passion, learning, and persistence… that challenges are fun, effort is satisfying, mistakes are welcome clues, and even failures can put people on the path to success.
How can this help your teachers?

- Select one important idea or connection we have discussed.

- How well do your teachers understand it?

- What’s one way you can promote their understanding or support a change in their practice?
Thank you!

☐ I would appreciate your feedback.

☐ These slides will be posted.

☐ Please email with any further questions, ideas, comments, and resources.

sendhil@gmail.com
Can Three Wrongs Make a Right? Helping Teachers and Coaches Use Assessment Items to Drive Students’ Thinking
43rd NCSM Annual Conference, Indianapolis — Tuesday, April 12, 2011
Sendhil Revuluri, University of Illinois at Chicago (sendhil@gmail.com)

**Selected Mathematics Assessment Resources** *(last updated April 2011)*

**Tests and items/tasks**

NAEP (National Assessment of Educational Progress), including released items
http://nces.ed.gov/nationsreportcard/mathematics/

JMAP: released items from New York State Regents exams, organized by topic
http://jmap.org/

Balanced Assessment in Mathematics
http://balancedassessment.concord.org/

MARS Tasks and supporting resources
http://www.nottingham.ac.uk/~ttzedweb/MARS/ and http://insidemathematics.org/

**Standards, frameworks, and consortia**

Common Core State Standards in Mathematics
http://corestandards.org/

Links to each state’s mathematics standards

College Board Standards for College Success
http://professionals.collegeboard.com/k-12/standards

ACT College Readiness Standards
http://www.act.org/standard/

Partnership for Assessment of Readiness for College and Careers

SMARTER Balanced Assessment Consortium
http://www.k12.wa.us/smarter/ and http://www.wested.org/cs/we/view/pj/582

**Other lists of resources**

Assessment in Mathematics Teaching, from the Math Forum
http://mathforum.org/mathed/assessment.html

Resources for authentic assessment in math (1994)
http://mathforum.org/sum94/project2.html
Books and articles

*Knowing What Students Know: The Science and Design of Educational Assessment*
The "bible" of educational research on assessment design and use at a variety of scales.
Center for Education (CFE), 2001
Read free online at [http://www.nap.edu/openbook.php?isbn=0309072727](http://www.nap.edu/openbook.php?isbn=0309072727)

Inside the Black Box: Raising Standards Through Classroom Assessment
The ur-text of formative assessment and how it can raise student achievement.
Paul Black and Dylan Wiliam, 1998
Download a version free at [http://snurl.com/black-and-wiliam](http://snurl.com/black-and-wiliam)

Working Inside the Black Box
Evolving teachers practice and students behavior to share responsibility for learning.
Paul Black, Christine Harrison, Clare Lee, Bethan Marshall, and Dylan Wiliam, 2004

Assessment in Support of Instruction and Learning: Bridging the Gap
Reconciling large-scale assessments for accountability with promoting student learning.
Committee on Assessment in Support of Instruction and Learning, NRC, 2003
Download free at [http://www.nap.edu/catalog/10802.html](http://www.nap.edu/catalog/10802.html)

*Understanding by Design*
The go-to reference on backwards design.
Grant Wiggins and Jay McTighe, 2005 (second edition)
[http://snurl.com/wiggins](http://snurl.com/wiggins)

*The Truth About Testing: An Educator's Call to Action*
A pithy, policy-oriented essay on how testing is mis-applied, and what we can do about it.
W. James Popham, 2001

*Mathematics Assessment: A Practical Handbook* for grade bands K–2, 3–5, 6–8, and 9–12
*Mathematics Assessment: Cases and Discussion Questions* for grade bands K–5 and 6–12
*Mathematics Assessment Sampler* for for grade bands PK–2, 3–5, 6–8, and 9–12
Published by NCTM between 1998 and 2006

When Assessment Guides Instruction: Silicon Valley’s Mathematics Assessment Collaborative
A chapter from MSRI’s *Assessing Mathematical Proficiency*, edited by Alan H. Schoenfeld
David Foster, Pendred Noyce and Sara Spiegel, 2007

Would you like an electronic version of this list, or the slides from this session? Just ask!
Do you have any useful resources related to mathematics assessment? Please share them!
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sendhil@gmail.com