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

Sendhil Revuluri

Senior Curriculum Developer and Senior Coach

Office of High School Development and
Learning Sciences Research Institute,
University of Illinois at Chicago

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.

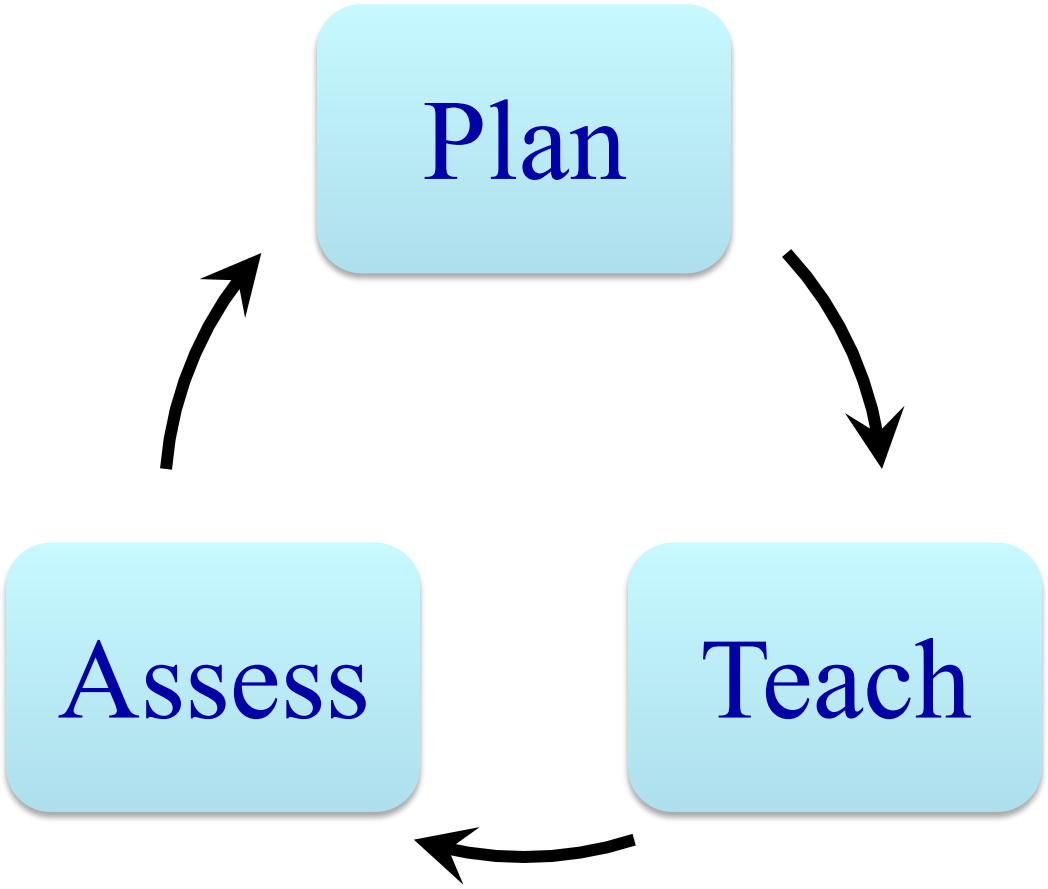
Let's get ready: some questions

- 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?

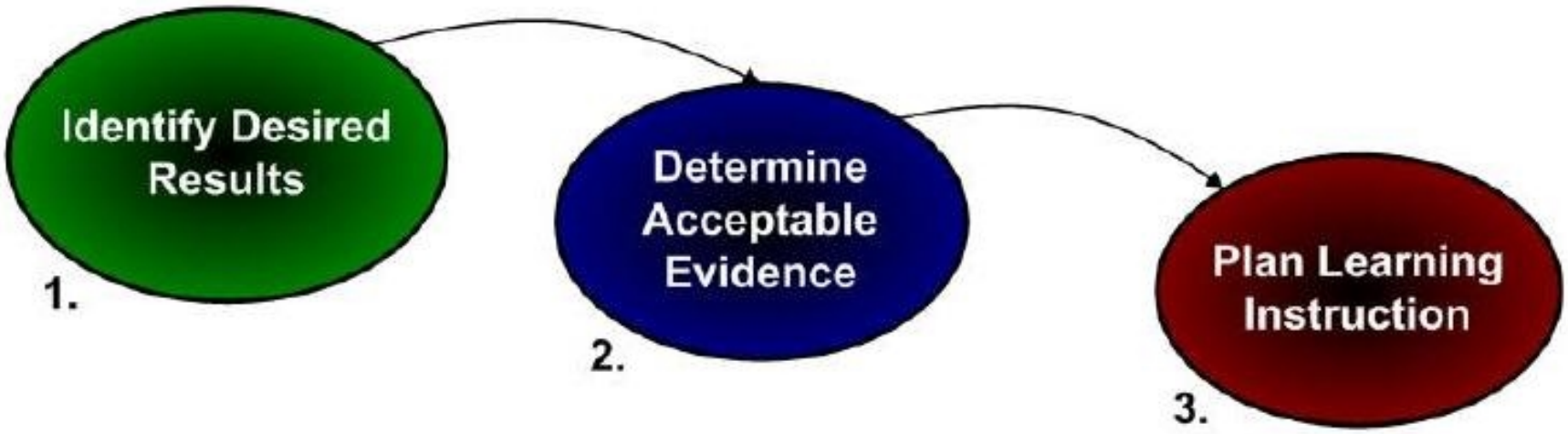
I: Some very brief foundations

- 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?

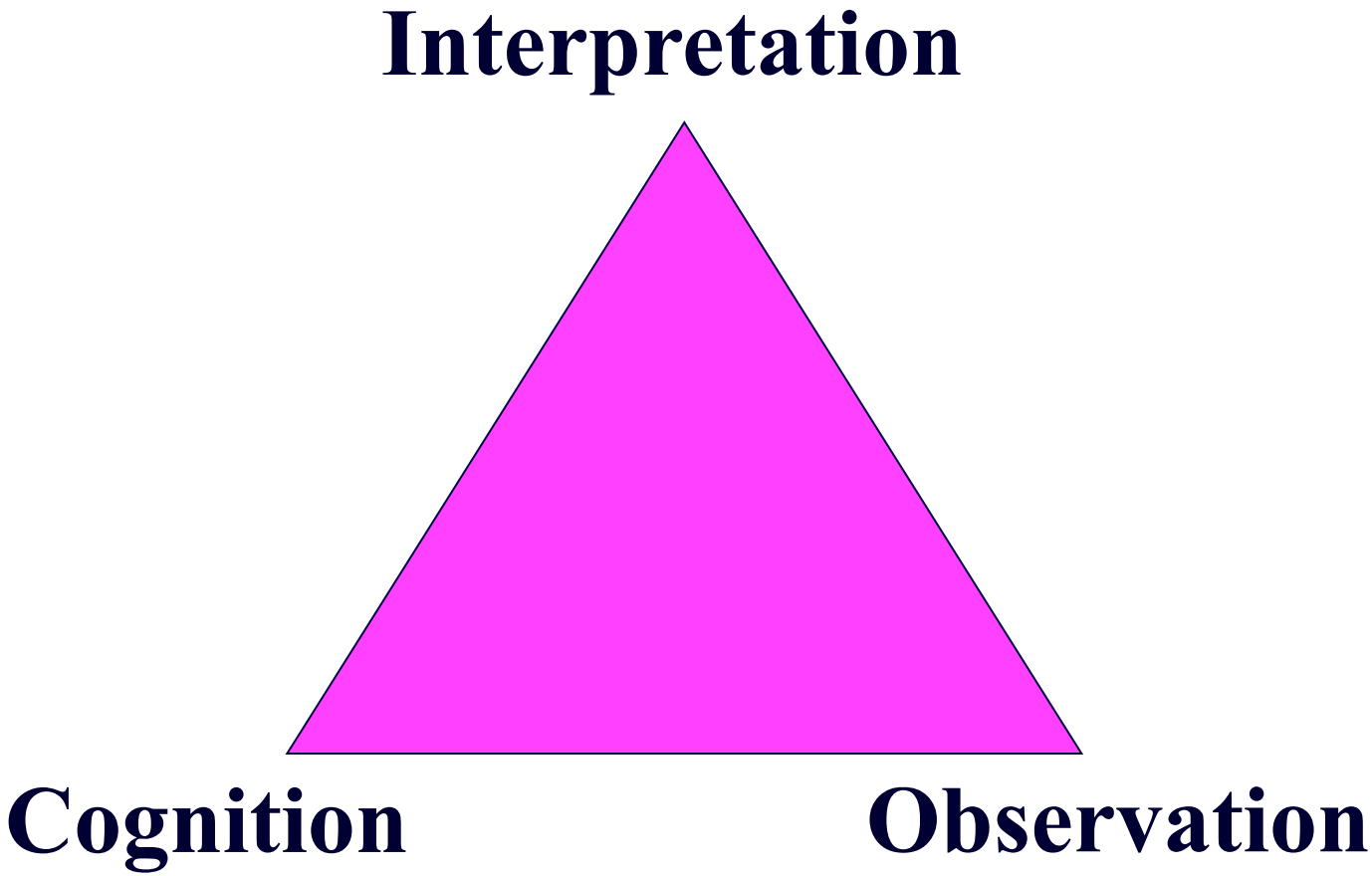
Assessment is part of teaching



Understanding by Design



The assessment triangle



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

A. 18.2 cm

B. 18.2 cm^2

C. 19.98 cm

D. 19.98 cm^2

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

		Identify relation as function from ordered pairs	Evaluate composition of functions	Identify function from graph	Represent function as table from arrow diagram	Solve quadratic trigonometric equation	Apply trig identities to evaluate expression	Identify function from equation	Write rule of composition of functions	Identify absolute value function from graph	Identify equation of inverse of function	Application problem with direct variation	Application problem with inverse variation	Find range of function givenrule and domain	Identify graph of inverse variation	Identify one-to-one function from graph		
Last	**First**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**Total**	
		4	**6**	**6**	**6**	**12**	**12**	**5**	**7**	**5**	**5**	**6**	**7**	*6*	**4**	**6**	**91**	**%**
###	###	4	6	6	5	8	12	5		5	4	0					**55**	**60%**
###	###	4	4	6	5	10	12	5	6	5	5	6	7	0	4	5	**84**	92%
###	###	4	6	6	4	8	8	5	7	5	5	6	2	1	4	6	**77**	85%
###	###	3	1	5	4	12	12	2	7	5	4	6	2	6	4	3	**76**	84%
###	###	4	1	5	4	8	12	4	2	3	4	6	2		0		**55**	**60%**
###	###	4	6	4	5	10	12	4	7	5	4	6	2		0	6	**75**	82%
###	###	4	4	6	6	10	7	3	7	5	5	6	2	3	0		**68**	75%
###	###	4	6	6	6	12	12	5	7	5	5	6	7	6	5	9	**101**	111%
###	###	4	6	6	5	12	12	3	7	5	5	4	2	5	0	8	**84**	92%
###	###	4	2	6	6	4	2	2	4	5	5	6	7			4	**57**	**63%**
###	###	4	2	6	5	12	12	4	3	5		6	2	6	0	2	**69**	76%
###	###	4	6	6	5	10	4	3	8	5	5	6	2		4		**68**	75%
	Avg	98%	**69%**	94%	83%	81%	81%	75%	**77%**	97%	85%	89%	**44%**	38%	**44%**	**60%**	12	87%
	SD	7%	35%	11%	12%	20%	30%	23%	28%	12%	10%	30%	33%	42%	56%	*40%*		

Across time: Proficiencies

VANGUARD HIGH SCHOOL

Geometry — Fall Proficiencies

Student name: Year: **2006/7**

Assessments	Angle Relationships		Area and Perimeter		Similarity	Right Triangle Trigonometry		Volume and Surface Area	
	Angle A – *recognizes angle relationships and can find missing angles*	**Angle B** – *can find interior and exterior angles in polygons*	**Area A** – *can determine when area and perimeter are relevant and can find for various polygons*	**Area B** – *determines when to use trig and P.T. in complex problems that don't directly ask*	Can determine if two shapes are similar and find missing lengths in similar shapes	**Trig A** – *can apply trig ratios to find missing lengths in right triangles*	**Trig B** – *Can decide when, where, and how to apply trigonometry in situations beyond right triangles*	**Volume A** – *can explain the difference between (surface) area, perimeter, and volume*	**Volume B** – *knows when volume and surface area should be used, and can find both*
1.23.07	NY	NY	**P**	NY	**P+**	NY	NY	**P+**	NY

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

Test 8 Analysis

Name:

#	Topic of the problem	Possible	Earned	Key Ideas for Problem
1	Identify relation as function from ordered pairs	4		
2	Evaluate composition of functions	6		
3	Identify function from graphs	6		
4	Represent function as table from arrow diagram	6		
5	Solve quadratic trigonometric equation	12		
	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

Algebra 2 Test 8 Analysis					Date
Name:					
#	**Topic of the problem**	**Possible**	**Earned**	**Journal**	**Class %**	**Key Ideas for Problem**
1	**Evaluate composition of functions**	6			**49%**	
2	**Solve quadratic trigonometric equation**	12			80%	
3	**Identify absolute value function from graph**	5			77%	

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
http://www.educationworld.com/standards/state/toc/index.shtml#math

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
http://www.fldoe.org/parcc/ and http://www.achieve.org/PARCC

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

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

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
Download free at http://datause.cse.ucla.edu/DOCS/pb_wor_2004.pdf

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

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

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
See http://www.nctm.org/news/release.aspx?id=780 for more information and links

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
http://svmimac.org/ or http://library.msri.org/books/Book53/index.html

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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!
Sendhil Revuluri
sendhil@gmail.com