

Classroom-Based Formative Assessment Techniques to Guide Teaching and Learning



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Howard County Public Schools (MD)

Kansas MTSS Mathematics Conference • Wichita, KS

April 28, 2016 • 9:40-11:10 a.m.

Getting to Know You

- Where are you from?
- What do you do?
 - Mathematics Specialists / Instructional Leader?
 - Teachers?
 - Level?
 - Early childhood? Elementary? Middle? High?
 - Other? (e.g. special education, ESL, etc.)
 - Administrators?
 - Principal or Assistant Principal?
 - Supervisor/Curriculum Director?
 - Higher Ed? Mathematics Teacher Educators?
 - Consultants?
 - Other?



Howard County Public Schools

(Ellicott City, MD)

Our Mission

We cultivate a vibrant learning community that prepares students to thrive in a dynamic world.

Our Vision

Every student is inspired to learn and empowered to excel.

Goal 1 - Every student achieves academic excellence in an inspiring, engaging, and supportive environment.

Goal 2 - Every staff member is engaged, supported, and successful.

Goal 3 - Families and the community are engaged and supported as partners in education.

Goal 4 - Schools are supported by world-class organizational practices.

ELEMENTARY MATHEMATICS SPECIALISTS & TEACHER LEADERS PROJECT



Supporting the ongoing work of Elementary Mathematics Specialists--professionals who know and understand mathematics, and who effectively lead and mentor their colleagues.

LOGIN OR JOIN

A PARTNERSHIP OF:



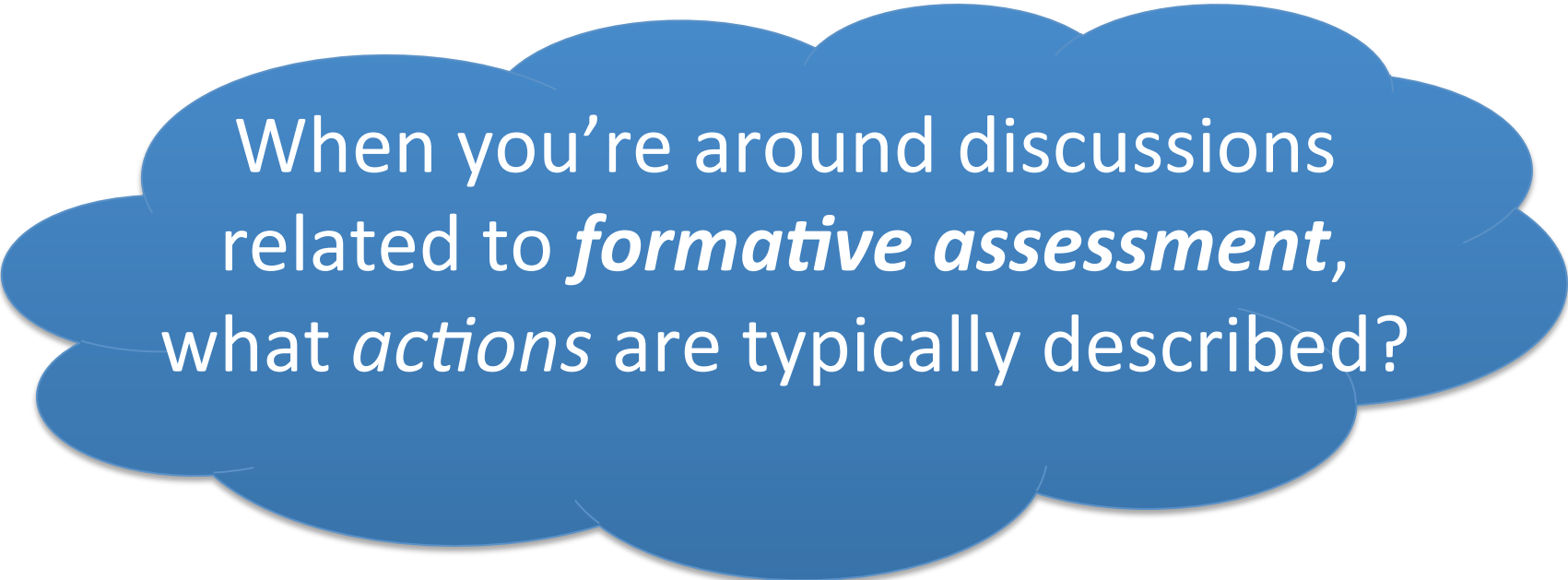
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Meet and Discuss



When you're around discussions related to *formative assessment*, what *actions* are typically described?

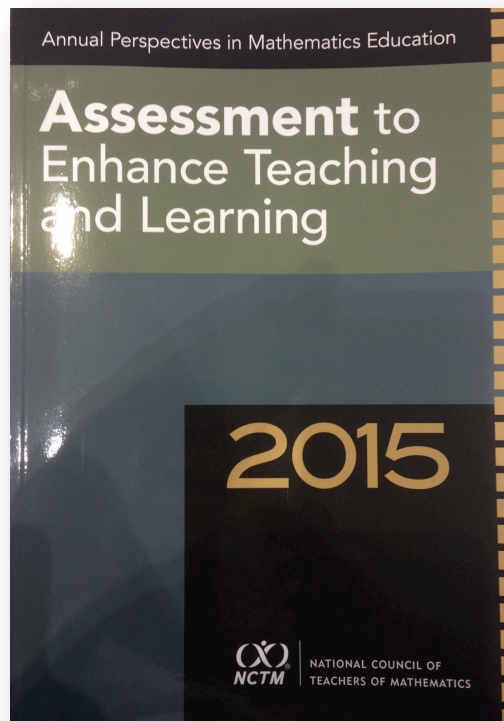
See: *TCM* – February 2015

news*
& views★

**Classroom-Based
Formative Assessments—
Guiding Teaching and Learning***

FRANCIS (SKIP) FENNELL, BARBARA ANN SWARTZ, BETH McCORD KOBETT, AND JONATHAN A. WRAY

And, also see NCTM's *APME*, 2015:



■ CHAPTER 5

Classroom-Based Formative Assessments: Guiding Teaching and Learning

Francis (Skip) Fennell, *McDaniel College, Westminster, Maryland*

Beth Kobett, *Stevenson University, Stevenson, Maryland*

Jonathan A. Wray, *Howard County Public Schools, Ellicott, Maryland*

Here's what we will do today!

- Consider the intentional, regular use of particular classroom-based formative assessment (CBFA) techniques, and
- Recognize how the use of CBFA's can truly guide both teaching and learning.

The classroom is your canvas...

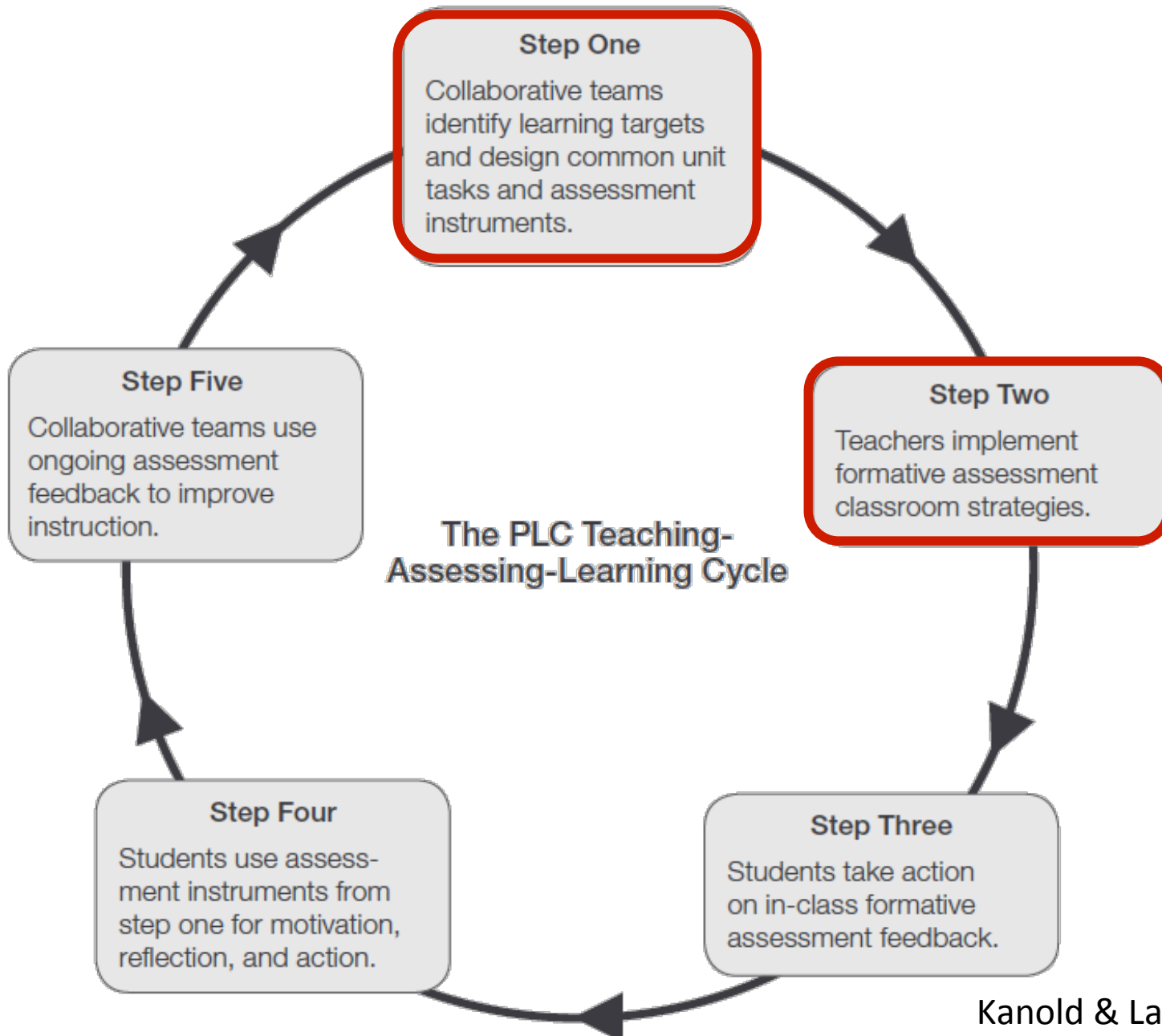


NCTM Research Brief: Formative Assessment

- a) Clarifying, sharing, and understanding goals for learning and criteria for success with learners; - pathfinder
- b) Engineering effective classroom discussions, questions, activities, and tasks that elicit evidence of students' learning;**
- c) Providing feedback that moves learning forward;**
- d) Activating students as owners of their own learning;
- e) Activating students as learning resources for one another.

NCTM "Key Strategies" for Effective Formative Assessment.

The PLC Teaching-Assessing-Learning Cycle



Linking assessment to planning and instruction is used to ***inform*** teaching and learning.

We actually know **a lot** about
formative assessment...

- The term **formative assessment** has been with us for at least 70 years (e.g., Sueltz et al., 1946; Weaver, 1955)....
- Regular use of **classroom formative assessment** would raise student achievement by 0.4 to 0.7 of a standard deviation – enough to raise the U.S. into the top 5 countries in the international rankings for mathematics (Natriello, 1987; Crooks, 1998; Black and Wiliam, 1998).

Formative Assessment - Research

In an experimental design in which teachers regularly used formative assessment to drive instruction, their students made *almost twice as much progress over the year* as measured by externally scored standardized tests than their counterparts in other classrooms.

William, Lee, Harrison & Black, 2004

But...

Evidence suggests that actual day-to-day use of formative assessment is *not as prevalent in classrooms as one might expect* (Stiggins, 2013).

And...

Aside from teacher-made classroom tests, the integration of assessment and learning as an *interacting system* has been too little explored.

Glaser & Silver, 1994

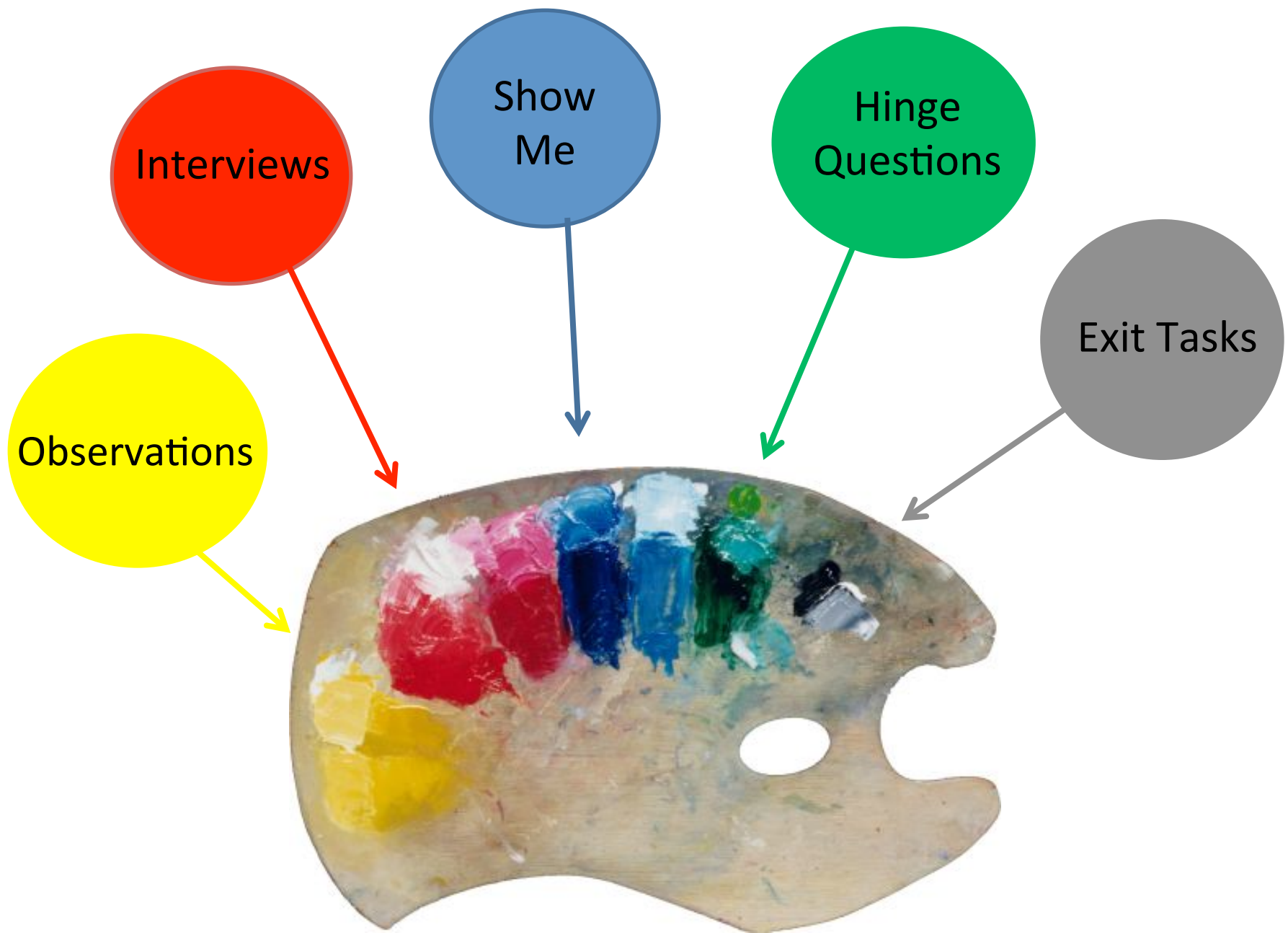
What we have done...

First, we recognized:

- an **overload** of publications, published assessments and services promising the *quick formative assessment fix*.
- a need to emphasize and enhance the use of classroom-based formative assessments – to guide teaching and learning.

So, we:

- Distilled seemingly endless suggestions and strategies to a ***small pallet*** of formative assessment ***techniques***.



Observations

“We know it is **more** informative to observe a student during a mathematical activity than to grade his papers.”

Freudenthal, 1973, p. 84

Note: Many teachers indicate that observing is something they have always done, but have not seen it as a formative assessment technique, or they need support to use observations to explicitly guide and *inform* their instructional decisions.

Elena and her 3 friends ate 9 cookies.
How many cookies did each friend eat?



Observation

Elena and her 3 friends ate 9 cookies.
How many cookies did each friend eat?

- What would you hope to observe?
- How would you *know it* if you saw it?
- How might you record/note the observation?
- What misconceptions might you observe?

You be the judge...

Elena and her 3 friends ate 9 cookies.
How many cookies did each friend eat?

The image shows several handwritten mathematical expressions and scribbles. At the top, there are four vertical scribbles. Below them, the word "Elena" is written. To the right of "Elena" are two fractions: $\frac{1}{4}$ and $\frac{1}{2}$. Below these are two more fractions: $\frac{1}{4}$ and $\frac{1}{4}$. To the left of these two fractions is a large, dark scribble. At the bottom left, there is a fraction $\frac{2}{4}$. At the bottom right, there is a fraction $\frac{2}{4}$ followed by a plus sign, another fraction $\frac{1}{4}$, and a final scribble.

Planning, Data Collection, and Reflection Tool: Observations

Intent of the Observation	Brief description/comments	Observed?		
		Yes	Partially	No
Mathematics Content				
Mathematical Practice(s)				
Student Engagement				
General Comment:				
Feedback to Students:				

Observations

Observe students as you ask them to decide how many hops of $3\frac{1}{4}$ on a number line are closest to but < 9 . Then observe students as they decide how many $3\frac{1}{4}$ number line hops are closest to but < 15 .

Planning (& Data Collection) Tool – Observations

Mathematical Practice:	
Key student dispositions: http://todaysmeet.com/students	Teacher actions (to promote student dispositions): http://todaysmeet.com/teachers
Comments:	

Observations

Observe students as you ask them to decide how many hops of $3\frac{1}{4}$ on a number line are closest to but < 9 . Then observe students as they decide how many $3\frac{1}{4}$ number line hops are closest to but < 15 .



Interviews

- Long history of use in mathematics and special education (Weaver, 1955; Ginsburg, 1997; Fennell, 1972, 1998 .
- Takes time – focused; 1-on-1 or small group
- Allows you to dig deeper
- Not intended to be deficit-based
- Provides a glimpse into what a child is thinking
- **Extends the observation.**

Observation/Interview rec's *from a while ago!*

- Observation, **discussion**, and interviews serve better than paper-pencil tests in evaluating a pupil's ability to understand the principles he/she uses (Sueltz, Boynton, & Sauble, **1946**, p. 145).
- Information is best collected through informal observation as students participate in class discussions, attempt to solve problems, and work on various assignments individually or in groups (NCTM, **1989**, p. 233).
- Observation of the pupil's oral and written work is a very important assessment procedure and should be encouraged. **Closely associated with the use of observations is the interview with the pupil regarding his/her daily work or his solution or attempted solutions of items of a test** (Spitzer, **1951**, p. 191).

Supporting Mathematics Reasoning and Sense-Making Through Interviews

What does this problem (solution) mean? Why does your method work?

What are some of the decisions you made? Do you agree or disagree with those decisions NOW?

Did you use any models or other representations to help solve the problem?

Did you solve the problem differently than your classmates? Are your solutions comparable?

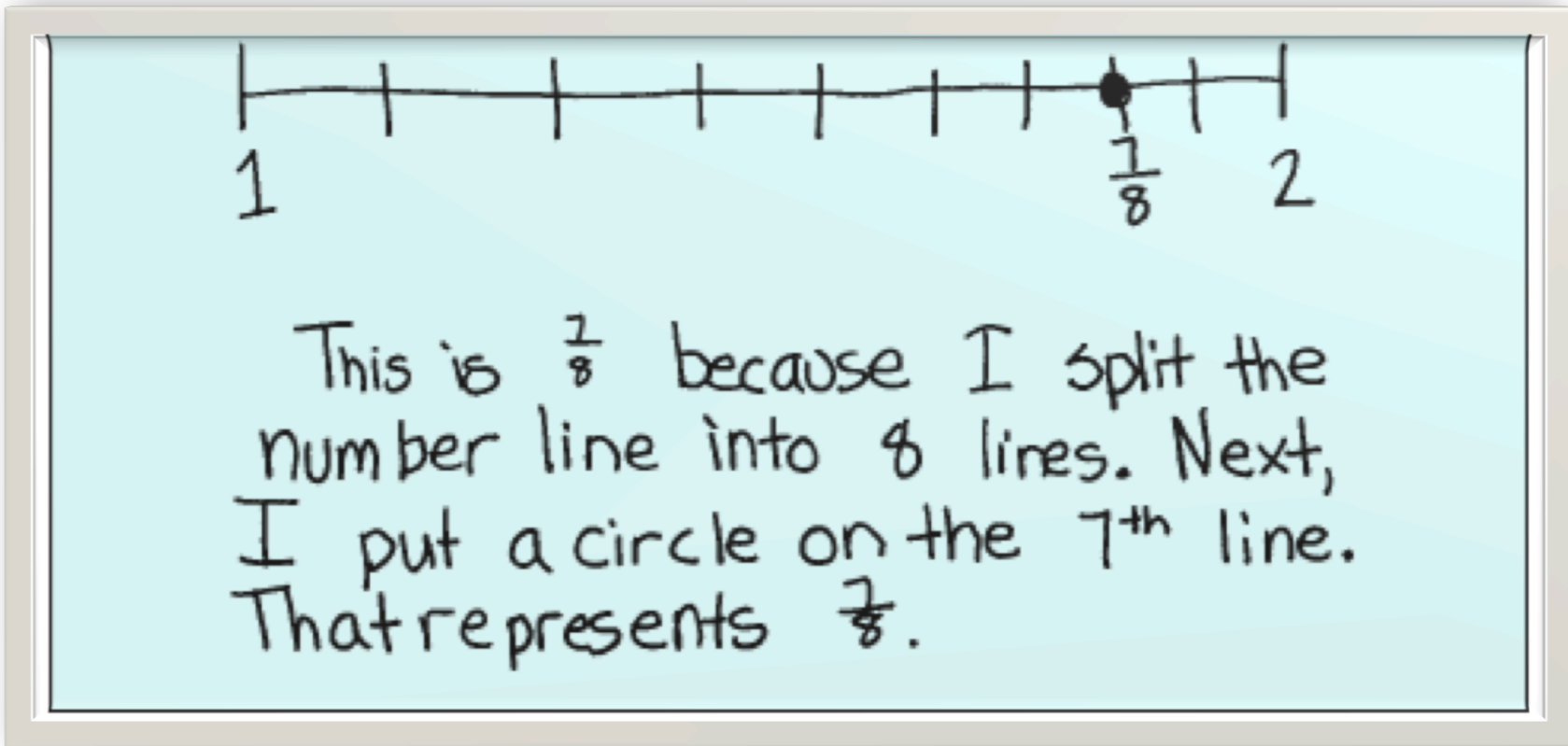
Would you like to change something about your solution now that you have heard thought of other ideas?

Does your answer make sense to you?

Are your explanations the same as anyone else's? How are they different?



Observations to Interviews





Interviews

- What would make you decide to work 1:1 with a student or small group?
- What questions might you ask? How might the questions be different?
- What will you anticipate from students? (Consider understandings AND possible misconceptions.)
- What follow-up questions might you ask?

Reflect and Share...

- Think of your work with <insert math content topic>
 - *What are some areas of concern, where you just might want to interview students about their thinking?*
 - Share your ideas here (e.g., *Comparing Fractions – understanding the importance of the size of, or relationship to, the whole*):

tinyurl.com/interviews16

- How does this impact your planning?
 - Consider ANY aspect of your work with the selected mathematics content topic.

Interview Prompt

Assessing	Student Response	Feedback to Student(s)	Teacher Comments/ Observations
Conceptual Understanding			
Procedural Fluency			
Strategies Used			
Student Prerequisites and Misconceptions			
Disposition			
General Comment:			

Adapted from Larson, Fennell, Adams, Dixon, Kobett, Wray, 2012 as cited in Fennell, Kobett & Wray, 2015, p. 55



Show Me

- A performance-based response to what a teacher observes.
- Combines elements of the observation and interview.
- A *stop-and-drop* activity where a student, small group of students or perhaps the entire class might be asked to show how something works, a problem solved, or a particular representation used.



Show Me

1. Provide a *show me* prompt that you might use for the following: *Compare two fractions with different numerators and denominators (e.g. $\frac{3}{4}$ and $\frac{5}{6}$) by creating common denominators or numerators or comparing them to the fraction benchmark $\frac{1}{2}$. (4.NF.A.2)*
2. What might you want a student or students to say as they describe their *show me* response?
3. How is this (the *show me* CBFA technique) different from an interview or observation?
4. When might YOU use a show me in your own setting?

Show Me examples

- Show at least three equivalent fractions for $\frac{1}{4}$ using a number line.
- Compare the fractions $\frac{3}{4}$, $\frac{5}{6}$ and $\frac{7}{8}$ using whatever representation you like.

Summing Up...

- **Observations** – Paying attention, monitoring
- **Interviewing** – specifics, “I want to know more about what I just observed.”
- ***Show Me*** – This is an explicit performance of what I would like to see demonstrated.

Hinge Questions



Hinge questions provide a check for understanding/proficiency at a ‘hinge-point’ in a lesson, or stated differently, success of the lesson hinges on responses to such questions as they provide an indication of whether the teacher can move from one important idea/concept/skill to the another (or not). Such responses impact both planning and instruction.

Think of your colleagues and their use of questioning...

What comes to mind?

Can you picture a colleague who is adept at questioning? Describe them.

Can you think of a colleague (perhaps me) who struggles with questioning?



Why the hinge...

“... For many teachers, diagnostic questions are most useful in the middle of an instructional sequence to check whether students have understood something before moving on. The central idea here is that the teacher designs each lesson with at least one “hinge” in the instructional sequence. The hinge is the point at which the teacher checks whether the class is ready to move on through the use of a diagnostic question.” (Wiliam, 2012)



Our take on the hinge question

- Hinge questions provide a check for understanding/proficiency at a ‘**hinge-point**’ in a lesson.
- Success of the lesson hinges on responses to such questions as they provide an indication of whether the teacher can move from one important idea/concept/skill to the another (or not).
 - Ideally students should respond within **one minute** and teachers be able to analyze and interpret responses within **fifteen seconds** (2011, p.101).
- Hinge question responses impact both planning and instruction.

Hinge Question

I walked $2\frac{3}{4}$ miles on Monday, Tuesday, and Wednesday. Have I walked more or less than 10 miles? How do you know?
How far did I walk?

Hinge Question Planning Tool

Hinge Question:		
	Yes	No
Will the hinge question assess important mathematical understandings of the day?		
Will students understand the question?		
Will students be able to respond in about a minute?		
Will expected responses be such that they can be analyzed and interpreted quickly?		
General consideration: Will responses assist in shaping planning for tomorrow's lesson? (circle one) YES NO (if no, revise hinge question)		
HOW?		

Types of Hinge Questions

1. Can you name a fraction that is greater than $\frac{3}{4}$?
2. Which of the fractions below is $> \frac{3}{4}$?
 - A. $\frac{1}{4}$
 - B. $\frac{1}{2}$
 - C. $\frac{4}{4}$
 - D. $\frac{3}{5}$

Note the differences – both regarding responses and creation and use.

Guidelines for Developing/Selecting **Hinge Questions**

1. Design hinge questions that elicit the right response for the right reason.
2. When using multiple choice (selected response) items, *incorrect answers* should be **interpretable**.
3. Sometimes it makes sense to administer a hinge question as a series of simple questions (used with *Every Pupil Response*).

Principles for Using Hinge Questions

1. Get a response from every student.
2. Do a quick check on understanding, instead of engaging in extended discussions.
3. On the basis of student responses, decide whether to go forward or back.

Thoughts on this one?

$$\frac{7}{2} \div \frac{9}{5} = ?$$

- an integer, like 6
- a *proper* fraction, like $\frac{1}{2}$ or $\frac{6}{10}$
- an *improper* fraction, like $\frac{10}{7}$ or $\frac{14}{8}$
- a mixed number, like $1 \frac{3}{4}$

“My Favorite No” (AKA - One of my favorite low-tech formative assessment techniques)



Source: Teaching Channel on Youtube, 2011
https://www.youtube.com/watch?v=Rulmok_9HVs



Exit Tasks

- The exit **task** is designed to provide a capstone problem or exercise that captures the major focus of the lesson of the day. This is a class assessment tool, and like the hinge question, student responses to the exit task help in identifying needs and in the planning for the next day's lesson.
- See handout for more information.

Exit Task

Bree's Pizza Palace has to load boxes of cheese. Each box weighs $5\frac{3}{4}$ pounds. There were 4 boxes. *Was the total weight < or > 25 lbs.? Write a response to show how you know.*

Here's another...

The fractions below indicate how much of a race each tricycle has completed. Make a prediction and compare the predicted order of finish.



$\frac{1}{2}$



$\frac{1}{4}$



$\frac{5}{6}$



$\frac{2}{3}$

Year long pilot – with teachers...

Q: Has working with the CBFA's made a positive impact on your work with teachers?

- 1-5 rating scale
(1) Strongly disagree (5) Strongly agree
- Mean rating: 3.78
- Median rating: 4
- n = 32

Year long pilot – CBFA's and planning

Q: Can you now claim that teachers consider classroom based formative assessment as they plan lessons for teaching mathematics?

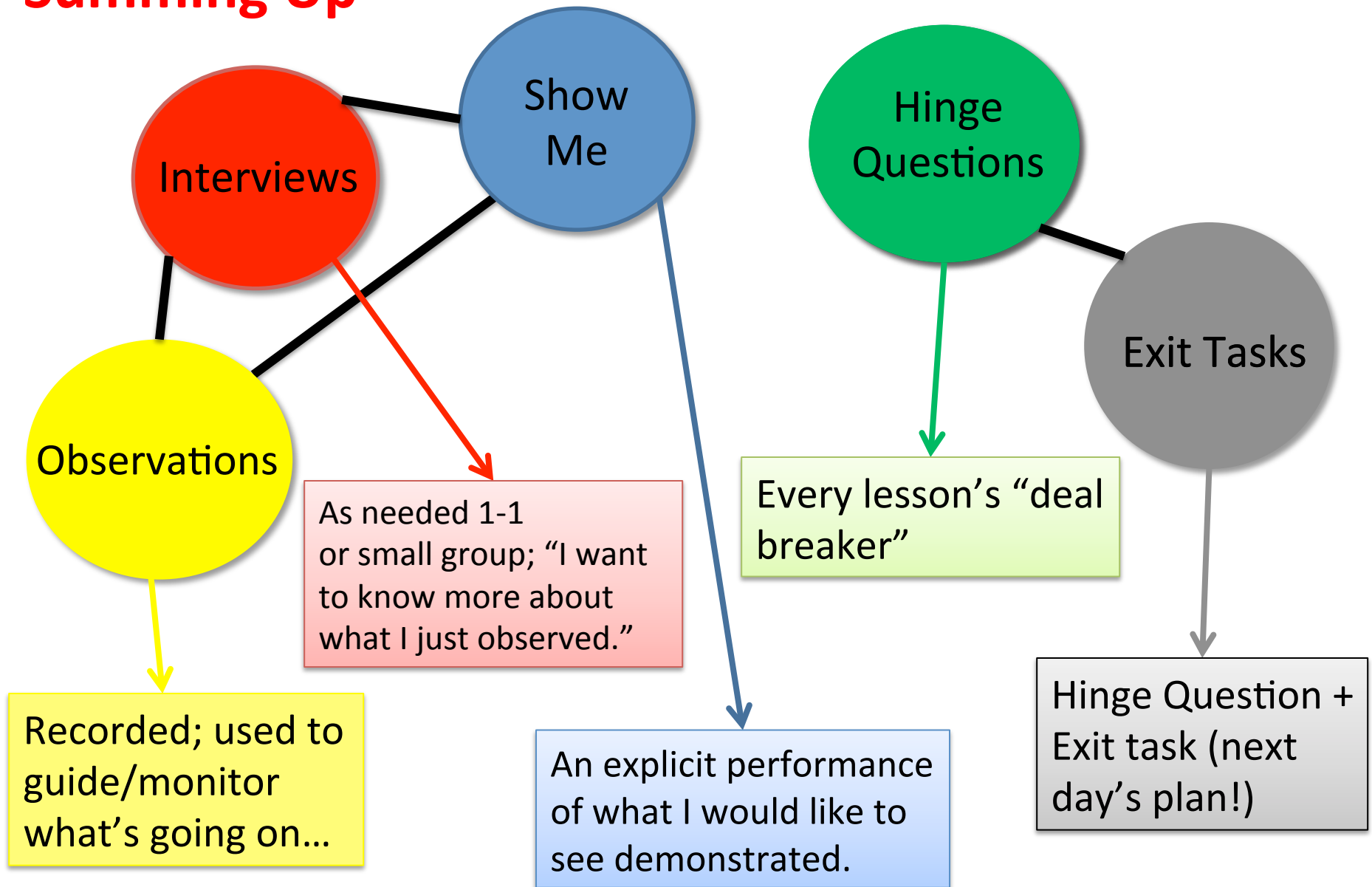
- 1-5 rating scale
(1) Strongly disagree (5) Strongly agree
- Mean rating: 3.30
- Median rating: 3
- n = 33

Year long pilot – CBFA’s and teaching

Q: Can you claim that teachers regularly (as in every day) use classroom based formative assessment as they implement mathematics lessons.

- 1-5 rating scale
(1) Strongly disagree (5) Strongly agree
- Mean rating: 3.32
- Median rating: 3
- n = 31

Summing Up



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-by-day.

Love this...

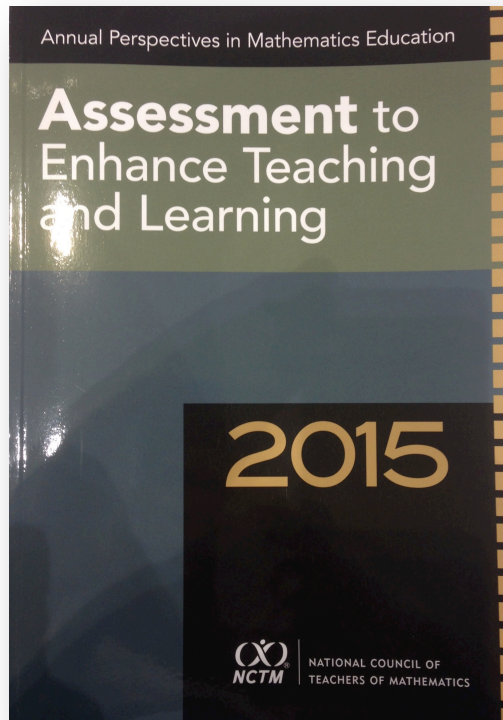
Thompson and William, 2007

Assessment Resources...

- Illustrative Math Project - <http://illustrativemathematics.org>
- Institute for Mathematics and Education – University of Arizona; Bill McCallum - ime.math.arizona.edu
- Dana Center and Agile Mind: Common Core Tool Box - <http://ccsstoolbox.org>
- Mathematics Assessment Project (MAP) - <http://map.mathshell.org>

And...

NCTM's *Annual Perspectives in Mathematics Ed 2015: Assessment to Enhance Learning and Teaching*



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ALSO - *Assessing Math Everyday: 5 Classroom-Based Techniques That Work!* (Corwin, 2017)

Thank you!

Slides/Handouts:

<http://jonathanwray.com>