Measuring Student Learning in Mathematics

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Kansas College and Career Ready Standards

Session Learning Goals

1. *Consider how we, as math leaders, can use **Principles to Actions** to support improvement toward excellent mathematics programs and effective teaching and learning of mathematics.*

2. *Recognize those aspects of our instructional practice that provide high leverage in strengthening and furthering students' success in learning of rigorous mathematics*

The Need for Deeper Learning in Math

* “Rigor refers to deep, authentic command of mathematical concepts, not making math harder or introducing topics at earlier grades”*
* “Educators will need to pursue, with equal intensity, three aspects of rigor in the major work of each grade: conceptual understanding, procedural skills and fluency, and application.”*
* This is reflected in assessment levels reported on new assessment

*http://www.corestandards.org/other-resources/key-shifts-in-mathematics/

KCCRA PERFORMANCE LEVELS

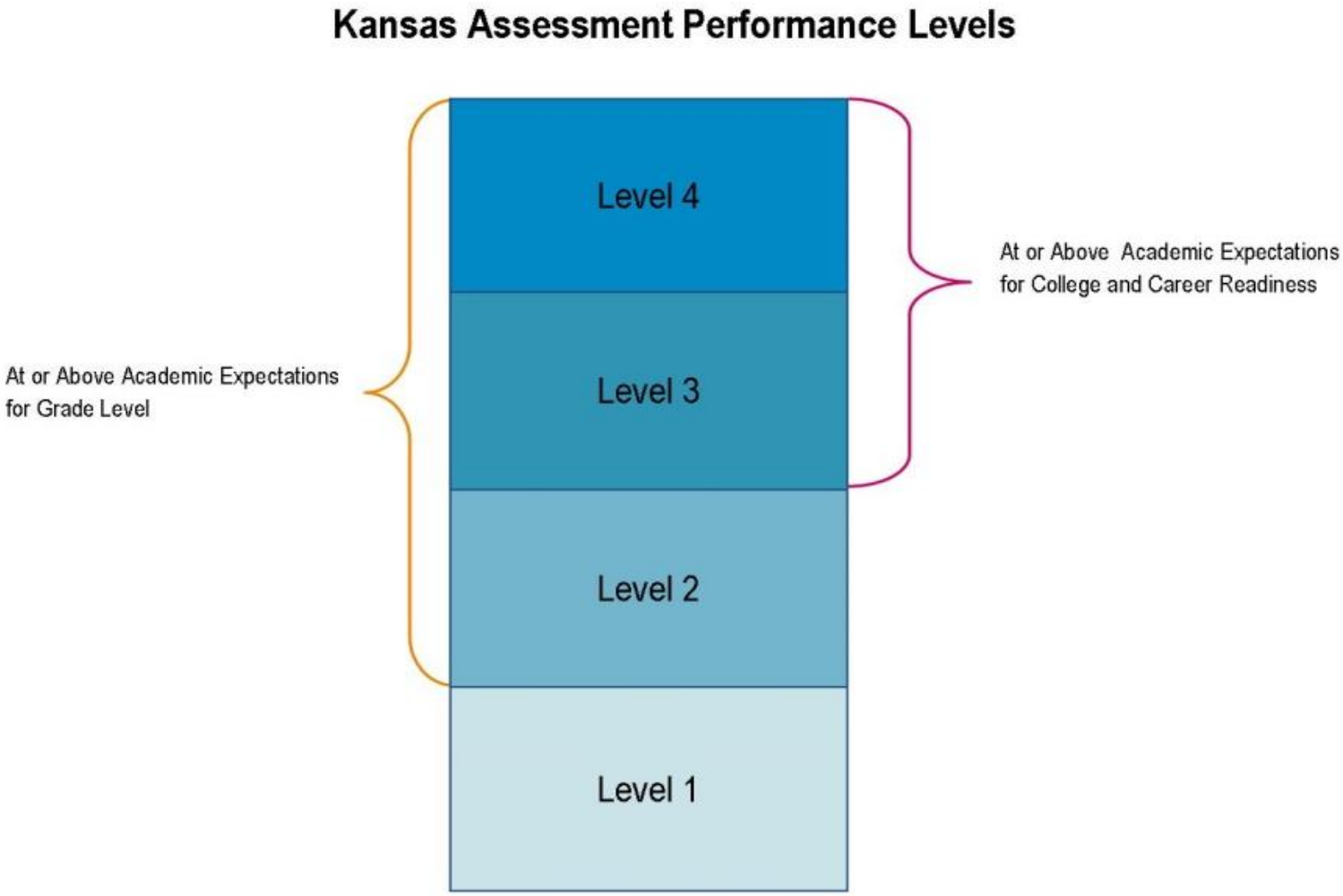
* *Level 1*: indicates that a student is not performing at grade level standards, and additional supports are needed.

* *Level 2*: indicates that the student is doing grade-level work as defined by the standards but not at the depth or level of rigor to be considered on-track for college readiness.

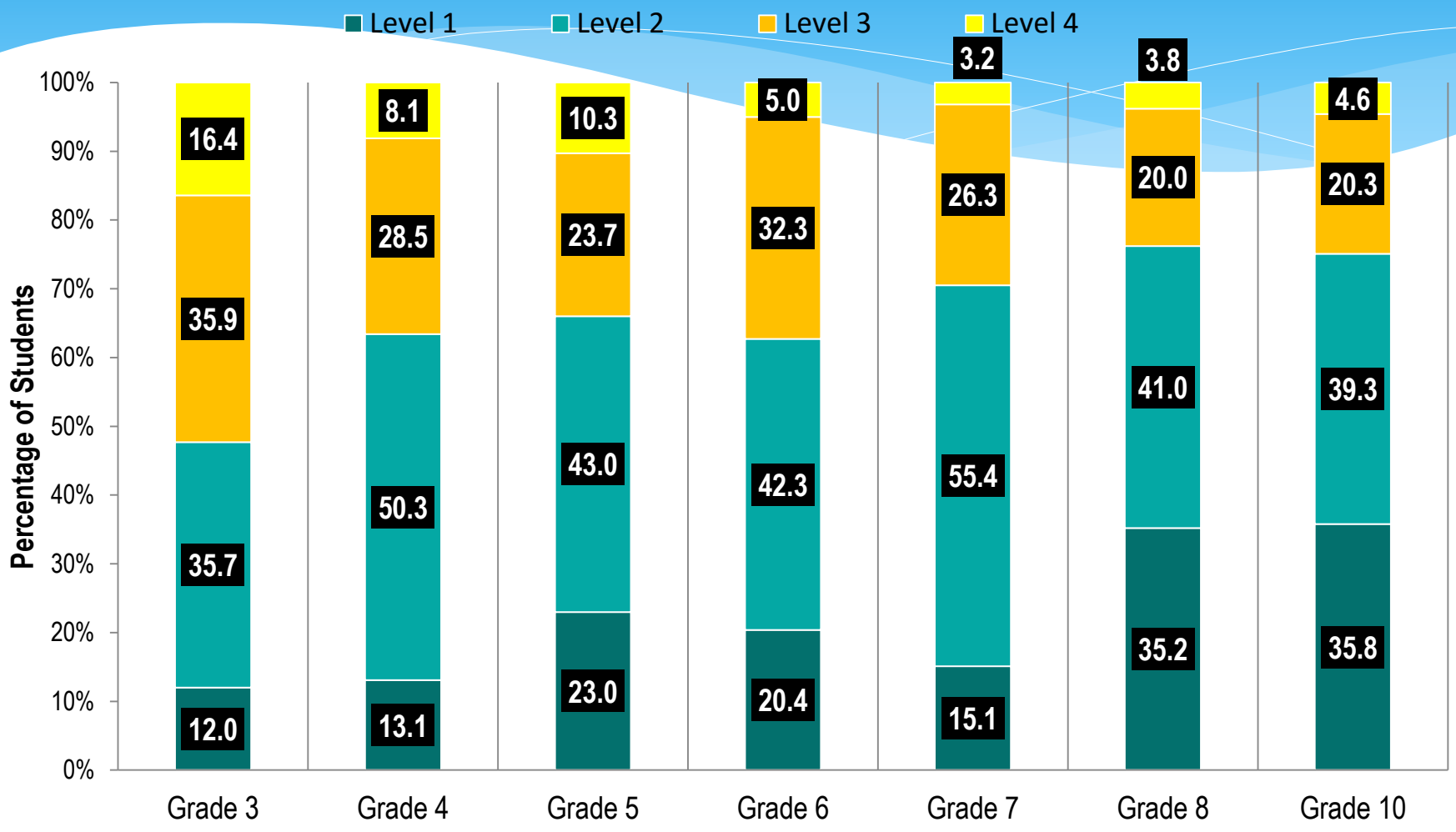
* *Level 3*: indicates that the student is performing at academic expectations for that grade level and is on track to being college ready.

* *Level 4*: indicates that the student is performing above expectations for that grade level and is on track to being college ready

Kansas Assessment Performance Levels

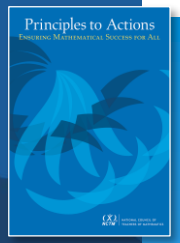


KCCRA: State Math Results, 2015



Key Questions

* How do we fill the gap between adoption of rigorous standards and effective implementation?
* How do we turn the opportunity of the standards into reality?
* What principles and actions are essential for a high-quality mathematics program for all students?



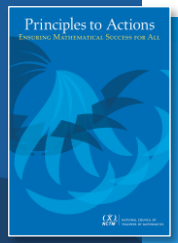
Principles to Actions: Ensuring Mathematical Success for All

The overarching message is that effective teaching is the non-negotiable core necessary to ensure that all students learn mathematics. The six guiding principles constitute the foundation of PtA that describe high-quality mathematics education.

NCTM. (2014). *Principles to Actions: Ensuring Mathematical Success for All.* Reston, VA: NCTM.

Principles to Action discusses these realities and actions for overcoming them:

* Too much focus is on learning procedures without any connection to meaning, understanding, or the applications that require these procedures.
* Too many students are limited by lower expectations and narrower curricula of remedial tracks from which few ever emerge.
* Too many teachers have limited access to the instructional materials, tools, and technology that they need.
* Too much weight is placed on results from assessments that emphasize skills and fact recall and fail to give attention to problem solving and reasoning.
* Too many math teachers are isolated without the benefits of collaborative structures and coaching, and with inadequate professional development related to mathematical teaching and learning.

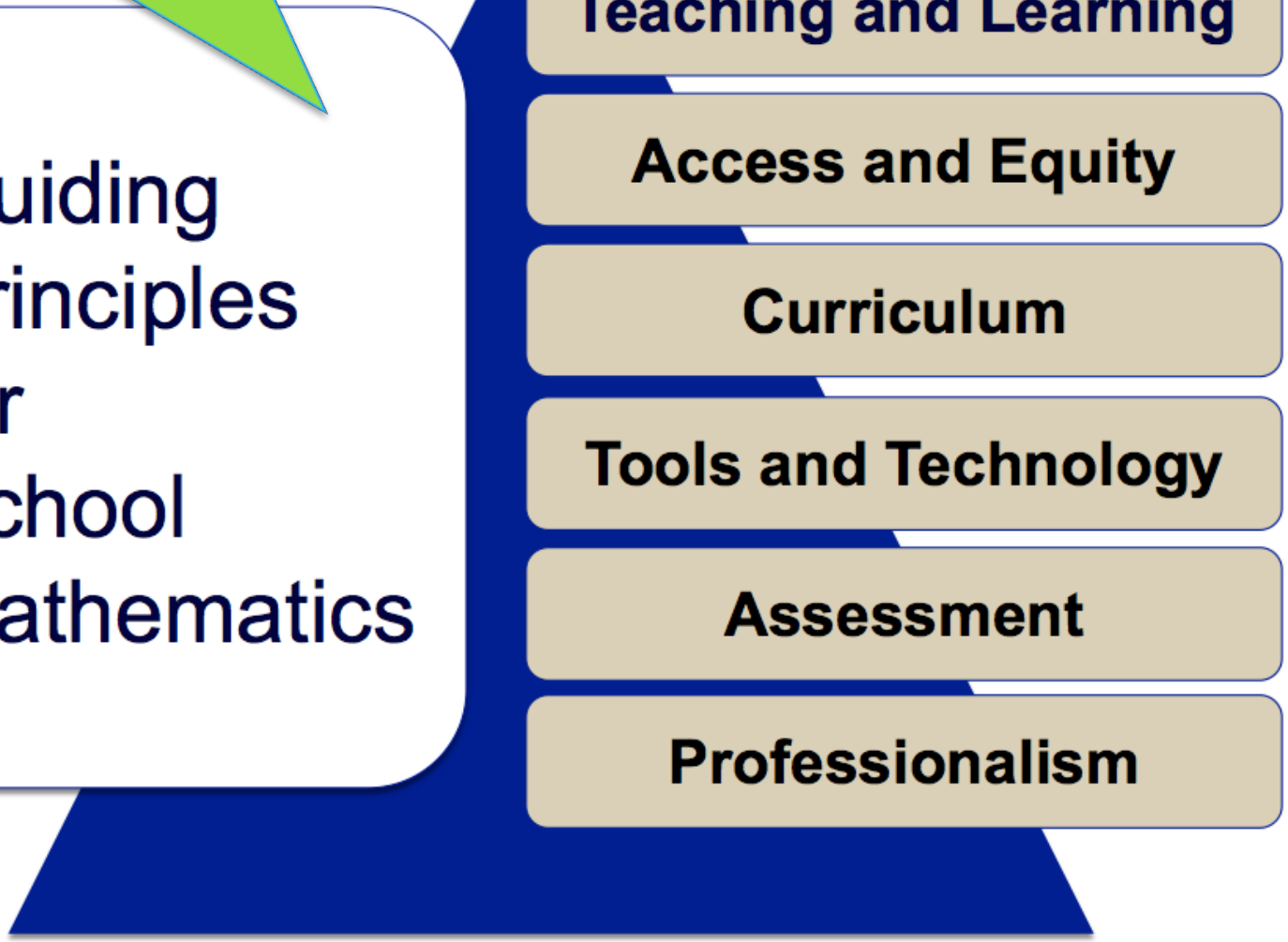


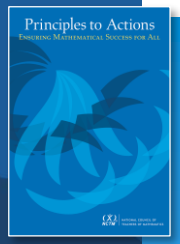
Guiding Principles for School Mathematics

1. **Teaching and Learning**
2. **Access and Equity**
3. **Curriculum**
4. **Tools and Technology**
5. **Assessment**
6. **Professionalism**

→ Essential Elements of Effective Mathematics Programs

What does the work related to these principles look like in your school or district?





For Each Principle

- Productive and Unproductive Beliefs are Listed
- Obstacles to Implementing the Principle are Outlined
- Overcoming the Obstacles
- Taking Action
  - Leaders and Policymakers
  - Principles, Coaches, Specialists, Other School Leaders
  - Teachers

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Effective Mathematics Teaching Practices

1. Establish mathematics goals to focus learning.
2. Implement tasks that promote reasoning and problem solving.
3. Use and connect mathematical representations.
4. Facilitate meaningful mathematical discourse.
5. Pose purposeful questions.
6. Build procedural fluency from conceptual understanding.
7. Support productive struggle in learning mathematics.
8. Elicit and use evidence of student thinking.

(NCTM, 2014)

Principles to Actions

Effective Mathematics Teaching Practices

The Case of Elizabeth Brovey and the Two Storage Tanks Task

Grade 8

This module was developed by Amy Hillen, Kennesaw State University. Video courtesy Pittsburgh Public Schools and the University of Pittsburgh Institute for Learning.

These materials are part of the ***Principles to Actions Professional Learning Toolkit: Teaching and Learning*** created by the project team that includes: Margaret Smith (chair), Victoria Bill (co-chair), Melissa Boston, Fredrick Dillon, Amy Hillen, DeAnn Huinker, Stephen Miller, Lynn Raith, and Michael Steele.

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The Case of Elizabeth Brovey and the Two Storage Tanks Task - Grade 8

Overview:

* Solve and discuss the two storage tanks task
* Watch a video clip of a teacher facilitating small group work using this task
* Discuss ways the teacher supports her students' learning of mathematics
* Connect specific teacher actions seen in the video clip to the Effective Mathematics Teaching Practices

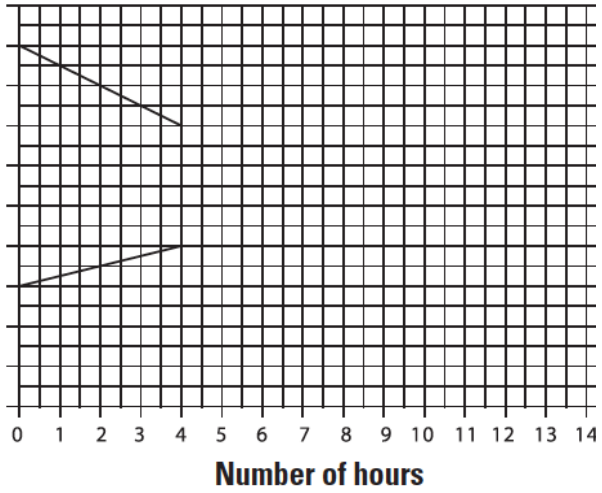
http://www.nctm.org/Conferences-and-Professional-Development/Principles-to-Actions-Toolkit/The-Case-of-Elizabeth-Brovey-and-the-Two-Storage-Tanks-Task/

The Two Storage Tanks Task

* What are all the ways the task can be solved?
* Which of these methods do you think your students will use?
* What misconceptions might students have?
* What errors might students make?

(Smith, Bill, Hughes, 2008, p. 134)

Two large storage tanks, T and W, contain water. T starts losing water at the same time additional water starts flowing into W. The graph below shows the amount of water in each tank over a period of time. Assume that the rates of water loss and water gain continue as shown.



1. When will the two tanks contain the same amount of water? Explain how you found your answer and interpret your solution in terms of the problem.

Ms. Brovey's
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Mathematical Content
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Connections to the KCCRSM Standards for Mathematical Practice (SMP)

1. **Make sense of problems and persevere in solving them**
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. **Attend to precision**
7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning

Connection

- 8.EE.C.8 - linear equa
- 8.F.B.4 - Use fu

Context of the Video Clip

School: Pittsburgh Classical Academy, Pittsburgh, PA

District: Pittsburgh Public Schools

Principal: Valerie Merlo

Teacher: Ms. Elizabeth Brovey, Math Coach

Class: 8th Grade Pre-Algebra

Curriculum: Connected Mathematics Project 2

Size: 27 students

At the time the video was filmed, Elizabeth Brovey was a coach at Classical Academy in the Pittsburgh Public School District. The students are mainstream eighth grade Pre-Algebra students. The lesson occurred in April.

(Elizabeth Brovey is currently a coach at Propel Andrew Street High School, a charter school in Pittsburgh, PA.)

Lens for Watching the Video Clip: Viewing #1

* As you watch the video clip, make note of what Ms. Brovey does to support her students' learning
* You may use the transcript of the video to make notes
* Have your math teaching practices list available

Effective Mathematics Teaching Practices

* What teaching practices does Ms. Brovey employ during this lesson? What is the evidence?

Session Focus

For the remainder of the session, we will focus on two of the teaching practices:

1. Pose purposeful questions
2. Elicit and use evidence of student thinking

Pose Purposeful Questions

Effective questions should:

- Reveal students' current understandings;
- Encourage students to explain, elaborate, or clarify their thinking; and
- Make the mathematics more visible and accessible for student examination and discussion.

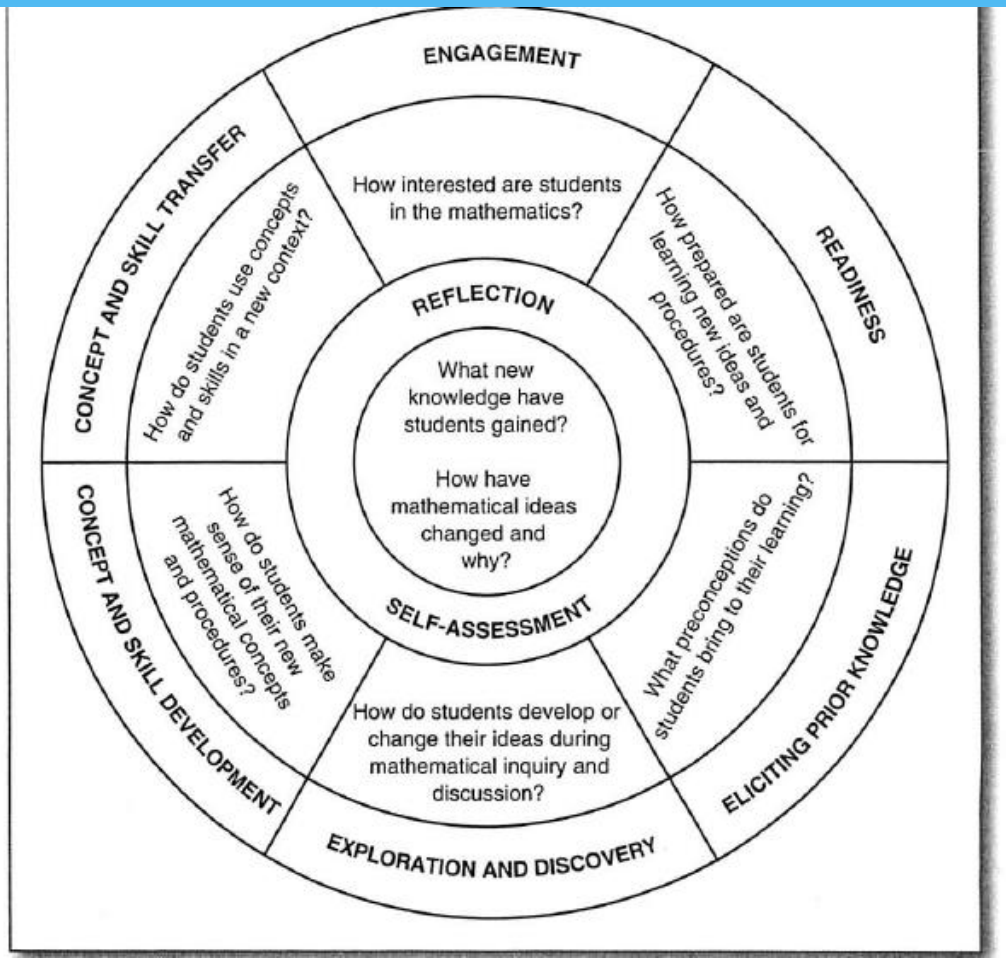
Teachers' questions are crucial in helping students make connections and learn important mathematics concepts. Teachers need to know how students typically think about particular concepts, how to determine what a particular student or group of students thinks about those ideas, and how to help students deepen their understanding.

(Weiss & Pasley, 2004)

Pose Purposeful questions

* Support engagement in SMPs
* Importance of patterns of question
* Importance of types of questions
* Attentiveness to the stage of the learning cycle in which questions are being asked

Mathematics Assessment, Instruction, Learning Cycle



- This cycle is used to help guide teachers in selecting an appropriate formative assessment technique
- Match the purpose and stage in instruction or learning process
- Reinforce the link between assessment, instruction, and learning
- Reflection and self-assessment are centerpieces that promote metacognition
- Stages…

Mathematics Formative Assessment: 75 Practical Strategies (Keeley & Tobey, 2011)

Types of Assessment Used

Stage in the MAIL Cycle	Type of Assessment Used
Engagement and Readiness	Diagnostic* Formative
Eliciting Prior Knowledge	Diagnostic* Formative
Exploration and Discovery	Formative
Concept and Skill Development	Formative
Concept and Skill Transfer	Formative and Summative
Reflection and Self-Assessment	Formative

Diagnostic assessment becomes formative when the data are used to inform teaching and learning!

Mathematics Formative Assessment: 75 Practical Strategies (Keeley & Tobey, 2011)

Elicit and Use Evidence of Student Thinking

Evidence should:

* Provide a window into students' thinking;
* Help the teacher determine the extent to which students are reaching the math learning goals; and
* Be used to make instructional decisions during the lesson and to prepare for subsequent lessons.

Formative assessment is an essentially interactive process, in which the teacher can find out whether what has been taught has been learned, and if not, to do something about it. Day-to-day formative assessment is one of the most powerful ways of improving learning in the mathematics classroom.

(Wiliam, 2007, pp. 1054; 1091)

Elicit and Use Evidence of Student Thinking

The gathering of evidence should neither be left to change nor occur sporadically…Waiting until the quiz on Friday or the unit test to find out whether students are making adequate progress is too late. **Rather it is important to identify and address potential learning gaps and misconceptions when it matters most to students, which is during instruction**, before errors or faulty reasoning becomes consolidated and more difficult to remediate.

(NCTM, 2014, p. 53)

Lens for Watching the Video Clip: Viewing #2

As you re-watch the video clip, pay particular attention to:

* Ms. Brovey's use of questioning
* The ways in which Ms. Brovey elicited students' thinking and used (or could she have used) this evidence to inform her instruction

Suggestions for using formative assessment techniques to strengthen the link between assessment, instruction, and learning

1. Make students' thinking explicit during problem-solving activities and math investigations
2. Create a classroom culture of ideas, not answers
3. Develop a discourse community
4. Encourage students to take risks
5. Encourage students to listen carefully
6. Use a variety of Formative Assessment Classroom Techniques (FACTs) in a variety of ways that make SENSE with the design of the lesson
7. Use a variety of grouping configurations
8. Encourage continuous reflection

Mathematics Formative Assessment: 75 Practical Strategies P. 25-26

My Favorite NO

* https://www.teachingchannel.org/videos/class-warm-up-routine
* How does this strategy allow for immediate re-teaching?
* What CRITERIA does she use to pick her favorite no?
* How does she use assessment data to inform her teaching?

Highlighting Mistakes: A Grading Strategy

* https://www.teachingchannel.org/videos/math-test-grading-tips
* What does she mean by “flow through” credit?
* “Why does she review her favorite mistakes instead of the correct answers before passing back the test?
* How does this grading strategy foster a class culture that values a class culture that values risks and learning from mistakes?

Reflection

How might you apply what you have learned about the effective mathematics teaching practices to your own classroom instruction?

NCTM Website: Principles to Actions

- Executive Summary (pdf)
- NCTM articles related to *Principles to Actions*
- Reflection Guide (pdf)
  (Tasks/questions, Connections to other MTP, Applications to practice)
- Power Points
- ALL Tasks from the book

http://www.nctm.org/principlestoactions/

KSDE Math Communications

* KSDE Math Listserv
  * Email: mfast@ksde.org to be added to list
* KSDE Math Website
  * http://community.ksde.org/Default.aspx?tabid=5255 to register on site
* Twitter: @ksdemath

Survey

* http://bit.ly/KSDE-PostTrainingSurvey

Questions or Comments

* Contact
  * Melissa Fast

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