# The Power of Teacher Collaboration to Support Students' Learning of the Common Core State Standards for Mathematics

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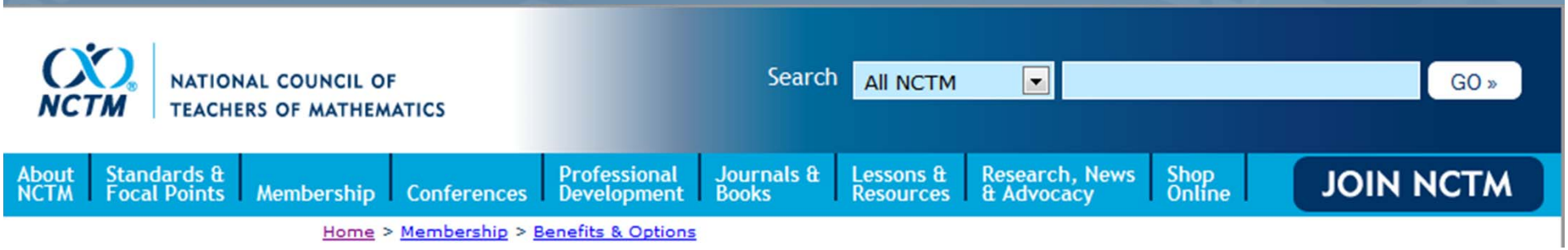


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  July, 2015, Chicago, IL
- *Engaging Students in Learning: Mathematical Practices and Process Standards*
  July, 2015, Anaheim, CA

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# Collaborative Team Tools


Available at nctm.org

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# Guiding Principles for School Mathematics

## *Professionalism*

In an excellent mathematics program, educators hold themselves and their colleagues accountable for the mathematical success of every student and for their personal and **collective professional growth** toward effective teaching and learning of mathematics.

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# Professionalism Obstacle

In too many schools, professional isolation severely undermines attempts to significantly increase professional collaboration … some teachers actually embrace the norms of isolation and autonomy. A danger in isolation is that it can lead to teachers developing inconsistencies in their practice that in turn can create inequities in student learning.

Principles to Actions, p. 100

# Collaboration Should Include

- An examination and prioritization of the mathematics content and mathematics practices students are to learn.
- The development and use of common assessments to determine if students have learned the agreed-on content and related mathematical practices.
- The use of data to drive continuous reflection and instructional decisions.

Principles to Actions, pp. 103-104

# Collaboration Should Include

- The setting of both long-term and short-term instructional goals.
- Development of action plans to implement when students demonstrate they have or have not attained the standards.
- Discussion, selection, and implementation of common research-informed instructional strategies and plans.

Principles to Actions, pp. 103-104

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# Rate Your Teams

**Table 1.1:**
**Seven Stages of Teacher Collaboration**

| Stage | Questions That Define This Stage |
|---|---|
| **Stage one:** Filling the time | What exactly are we supposed to do as a team? |
| **Stage two:** Sharing personal practice | What is everyone doing in his or her classroom for instruction, lesson planning, and assessment? |
| **Stage three:** Planning, planning, planning | What should we be teaching during this unit, and how do we lighten the load for each other? |
| **Stage four:** Developing common assessments | How will we know if students learned the standards? What does mastery look like for the standards in this unit? |
| **Stage five:** Analyzing student learning | Are students learning what they are supposed to be learning? Do we agree on student evidence of learning? |
| **Stage six:** Adapting instruction to student needs | How can we adjust instruction to help those students struggling and those exceeding expectations? |
| **Stage seven:** Reflecting on instruction | Which lesson-design practices are most effective with our students? |

# Four PLC Questions

1. What do we expect students to learn?
2. How will we know students learned it?
3. What will we do when students' learning is incomplete?
4. What will we do when students do learn?

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# High-Leverage Unit-By-Unit Actions of Mathematics Collaborative Teams

- Teaching and Learning
- **Assessment Instruments and Tools**
- Formative Assessment Feedback

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# Guiding Principles for School Mathematics

## *Assessment*

*An excellent mathematics program ensures that assessment is an integral part of instruction,* ***provides evidence of proficiency with important mathematics content and practices****, includes a variety of strategies and data sources, and informs feedback to students, instructional decisions and program improvement.*

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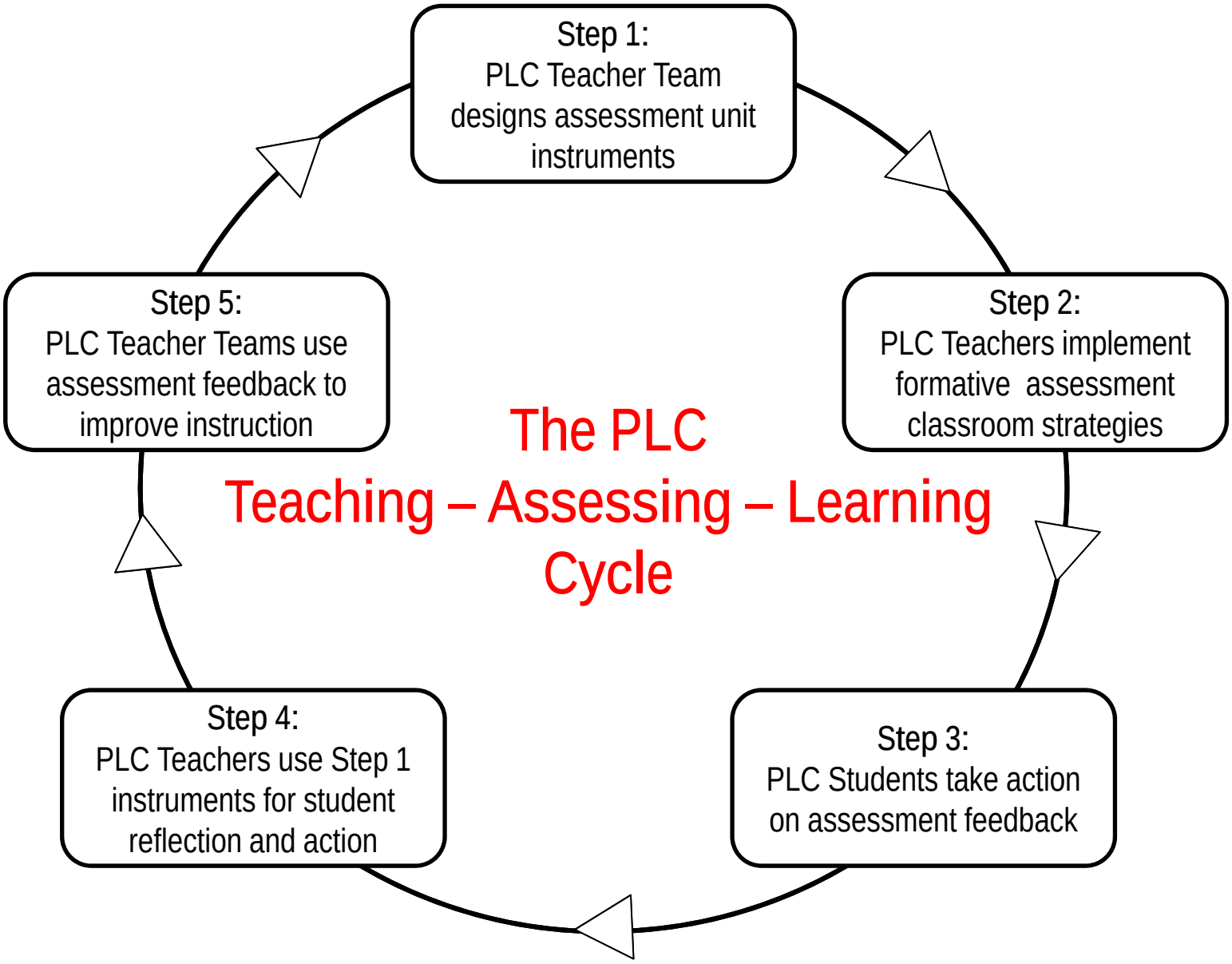
# Collaborative Team Actions: Assessment Instruments and Tools

1. The team designs and implements agreed-on common assessment instruments based on high quality exam designs. The collaborative team designs all unit exams, unit quizzes, final exams, writing assignments, and projects for the course.
2. The team designs and implements agreed-on common assessment instrument scoring rubrics for each assessment in advance of the exam.
3. The team designs and implements agreed-on common scoring and grading feedback (level of specificity to the feedback) of the assessment instruments to students.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# Why Common Assessments?

**7.RP.3** Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*

What assessment tasks would you use to assess students' proficiency with this standard?

# Why Common Assessments?

**7.RP.3** Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*

- Compute discount price? Total price with tax?
- Find the cost, given amount including tax and tax rate?
- Compute item cost, given both discount rate and tax rate?

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# TV Sales-Part A
# (PARCC Grade 7)

A store is advertising a sale with 10% off all items in the store. Sales tax is 5%.

A 32-inch television is regularly priced at $295.00. What is the total price of the television, including sales tax, if it was purchased on sale? Fill in the blank to complete the sentence. Round your answer to the nearest cent.


The total cost of the television is $ _____ .

Submit Answer

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# TV Sales-Part B
## (PARCC Grade 7)

Write your answers to the following problem in your answer booklet.

A store is advertising a sale with 10% off all items in the store. Sales tax is 5%.

Adam and Brandi are customers discussing how the discount and tax will be calculated.

Here is Adam's process for finding the total cost for any item in the store.

- Take 10% off the original price.
- Then, add the sales tax to the discounted price.

Adam represents his process as:

$$T = \underbrace{0.9p}_{\text{sale price}} + \underbrace{0.05(0.9p)}_{\text{sales tax}}$$

Here is Brandi's process for finding the total cost for any item in the store.

- Determine the original price of the item, including sales tax.
- Then, take 10% off.

Brandi represents her process as:

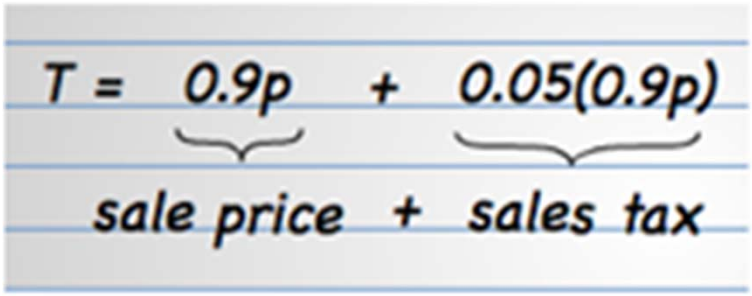
$$T = \underbrace{1.05p}_{\text{T.V. price plus tax}} - \underbrace{0.10(1.05p)}_{\text{10\% off discount}}$$

In both equations, $T$ represents the total cost of the television and $p$ represents the regular price.

Are they both correct? Use the properties of operations to justify your answer.

# TV Sales-Part B
## (PARCC Grade 7)

### Adam's Process




T = 1(0.9*p*) + 0.05(0.9*p*)

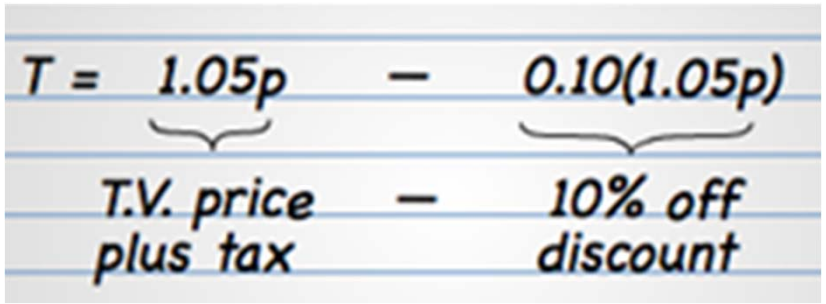
= (1 + 0.05)(0.9*p*)

= (1.05)(0.9*p*)

= (1.05)(0.9)*p*

= *0.945p*

### Brandi's Process




T = 1(1.05p) – (0.10)(1.05p)

= (1 – 0.10)(1.05*p*)

= (0.9)(1.05*p*)

= (1.05)(0.9)*p*

= *0.945p*

# TV Sales-Extension
# (PARCC Grade 7)

A store is advertising a sale with 10% off all items in the store. Sales tax is 5%.

A 32-inch television is regularly priced at $295.00. What is the total price of the television, including sales tax, if it was purchased on sale? Fill in the blank to complete the sentence. Round your answer to the nearest cent.


Amy says, “A 10% discount with 5% sales tax is the same as a 5% discount because 10% – 5% = 5%.

Is Amy correct? Use properties of operations to justify your answer.

# Tasks Clarify Expectations

- Range of content
- Depth of knowledge
- Type of reasoning and evidence of it
- Types of applications

# Tasks Clarify Expectations

**PARCC**

"[The prototypes] are designed to shine a light on important elements of the CCSS . . . "

**SBAC**

"The sample items and tasks illustrate the knowledge and skills students will be expected to demonstrate on the Smarter Balanced assessments, giving educators clear benchmarks to inform their instruction."

# Analyze PARCC & SBAC Prototypes

View actual prototypes at:

PARCC:
http://www.parcconline.org

SBAC:
http://smarterbalanced.org

# Effective Assessment Practice

Collaboratively analyze SBAC and PARCC prototype assessment tasks to develop common understanding of CCSSM proficiency expectations.

# If You Have Common Assessments

Are they really really good?

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# How Can You Evaluate the Quality of Your Assessments?

On what "basis" do you determine the characteristics of a high quality unit/chapter test?

# Analyzing Assessment Quality

| Assessment Indicators | Description of Level 1 | Requirements of the Indicator Are Not Present | Limited Requirements of This Indicator Are Present | Substantially Meets the Requirements of the Indicator | Fully Achieves the Requirements of the Indicator | Description of Level 4 |
|---|---|---|---|---|---|---|
| **Learning targets are given appropriate emphasis.** | Too much attention on one or two targets or on less important targets; number of points does not reflect importance. | 1 | 2 | 3 | 4 | The most important learning targets receive the most emphasis. |
| **Balance of procedural fluency and demonstration of understanding** | Test is not "rigor" balanced. Emphasis is on procedural knowledge and minimal cognitive demand for demonstrating understanding. | 1 | 2 | 3 | 4 | Test is balanced with product- and process-level questions. Higher cognitive demand and understanding tasks are present. |
| **Question phrasing (precision)** | Wording is vague or misleading. Vocabulary and precision of language is a struggle for student understanding. | 1 | 2 | 3 | 4 | Vocabulary is direct, fair and clearly understood. Students are expected to attend to precision in responses. |
| **Format and design of assessment tasks support valid inferences about students' knowledge** | Assessment contains items that may give misleading information about students' knowledge. Calculator usage not clear. | 1 | 2 | 3 | 4 | Assessment tasks support valid inferences and may include a variety of question types and formats to do so. |
| **Clarity of directions** | Directions are missing or unclear. | 1 | 2 | 3 | 4 | Directions are appropriate and clear. |
| **Visual presentation** | Assessment instrument is sloppy, disorganized, difficult to read, and offers no room for work. | 1 | 2 | 3 | 4 | Assessment instrument is neat, organized, easy to read, and well-spaced, with room for student work and teacher feedback |
| **Time allotment** | Few students can complete the assessment in the time allowed | 1 | 2 | 3 | 4 | Test can be successfully completed in time allowed |
| **Format and design promotes students' taking responsibility for their own learning.** | Learning targets are unclear; students not expected to analyze their performance. | 1 | 2 | 3 | 4 | Learning targets are clear and connected to the assessment questions, either on the test or another sheet. |

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http://files.solution-tree.com/pdfs/Reproducibles_CCM6-8/figure4.6.pdf

# Analyzing Assessment Quality

- Read the Assessment Instrument Evaluation Tool
- With table group, discuss categories

# Analyzing Assessment Quality

- Learning targets are given appropriate emphasis.
- Balance of procedural fluency and demonstration of understanding.
- Question phrasing (precision)
- Format and design of assessment tasks support valid inferences about students' knowledge
- Clarity of directions
- Visual presentation
- Time allotment
- Format supports students' taking responsibility for their own learning

# Analyzing An Assessment

- Work with a partner. Use the evaluation rubric to rate the quality of the Grade 7 Integer assessment on each dimension.
- What are the strengths/ weaknesses of this assessment?
- What would you do to improve the assessment?
- Discuss with your table-mates

# Compare Integers Test to "Properties of Integer Addition and Subtraction"

| Same | Different |
| --- | --- |

# Properties of Integer Addition and Subtraction

Ms. Lora is discussing properties of arithmetic with integers with students, asking them to say whether a statement is true or false and provide some reasoning to justify their conclusion.

1. For the statement "The sum of a negative integer and a positive integer is always positive." Keisha says "This is false. The sum *can* be positive, like 10 + -3 = 7. But, it can also be negative. For example, -9 + 3 is -6."

   Did Keisha provide a correct argument to explain why the statement is false? Explain why you think so.

# Properties of Integer Addition and Subtraction

2. For the statement "The sum of two negative integers is always negative." Mike says, "This is true. I tried lots of examples, like -3 + -2, -10 + -27, and even ones with big numbers, like -2,000 + -5,000. All the sums were negative. So this must be true."

   Has Mike provided a viable argument that the statement is true? ? Explain why you think so.

# Properties of Integer Addition and Subtraction

3. For the same statement "The sum of two negative integers is always negative." Dev says, "I agree with Mike that the statement is true, but I don't think giving examples is good enough to prove that it is always true. I wonder if I could use the number line to show that when you add two negative numbers together, the sum is always negative?"

   Is Dev's critique of Mike's argument correct? Explain why you think so.

   How could Dev use a number line to prove that the sum of two negative integers is always negative?

# Properties of Integer Addition and Subtraction

4. For the statement “The difference between two negative integers is always positive.” Joey says "This is true. Just like Keisha gave an example, I see that -3 - -8 = -3 + 8 = 5, so it is true.“

   Is Joey's argument correct? Explain why you think so.

# SMP 3.Construct viable arguments and critique the reasoning of others.

Mathematically proficient students understand and use stated assumptions, **definitions, and previously established results in constructing arguments.** They make conjectures and build a logical progression of statements to explore the truth of their conjectures. **They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples.** They justify their conclusions, communicate them to others, and respond to the arguments of others . . . . Mathematically proficient students are also able to **compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. . . . Students at all grades can listen or read the arguments of others, decide whether they make sense,** and ask useful questions to clarify or improve the arguments**.**

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# Understanding a Concept

- Explain it to someone else
- Represent it in multiple ways
- Apply it to solve simple and complex problems
- Reverse givens and unknowns
- Compare and contrast it to other concepts
- Use it as the foundation for learning other concepts

# Formats That Support Valid Inferences

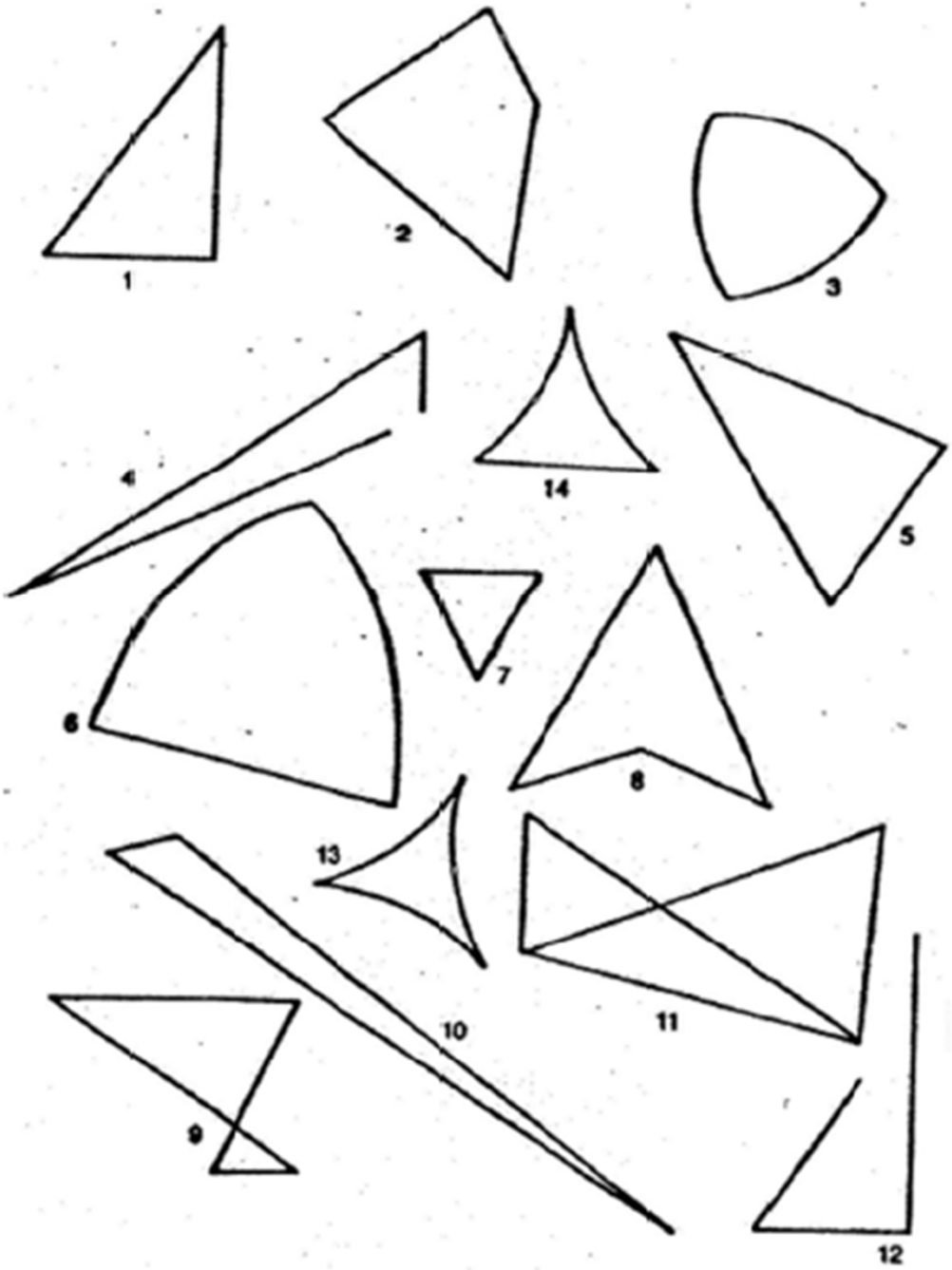
Learning target:

Understanding the definition of a triangle.

Performance task:

Draw a triangle.

# Circle All the Triangles



# Algebra 1 Proficiency Test Item

At the school carnival, Carmen sold 3 times as many hot dogs as Shawn. The two of them sold 152 hot dogs altogether. How many hot dogs did Carmen sell?

a. 13 b. 38 c. 51 d. 114 e. 148

b. 38

d. 114 

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# Algebra 1 Proficiency Test Item

At the school carnival, Carmen sold 3 times as many hot dogs as Shawn. The two of them sold 152 hot dogs altogether.

1. How many hot dogs did Shawn sell?

a. 13 b. 38 c. 51 d. 114 e. 148

2. How many hot dogs did Carmen sell?

a. 13 b. 38 c. 51 d. 114 e. 148

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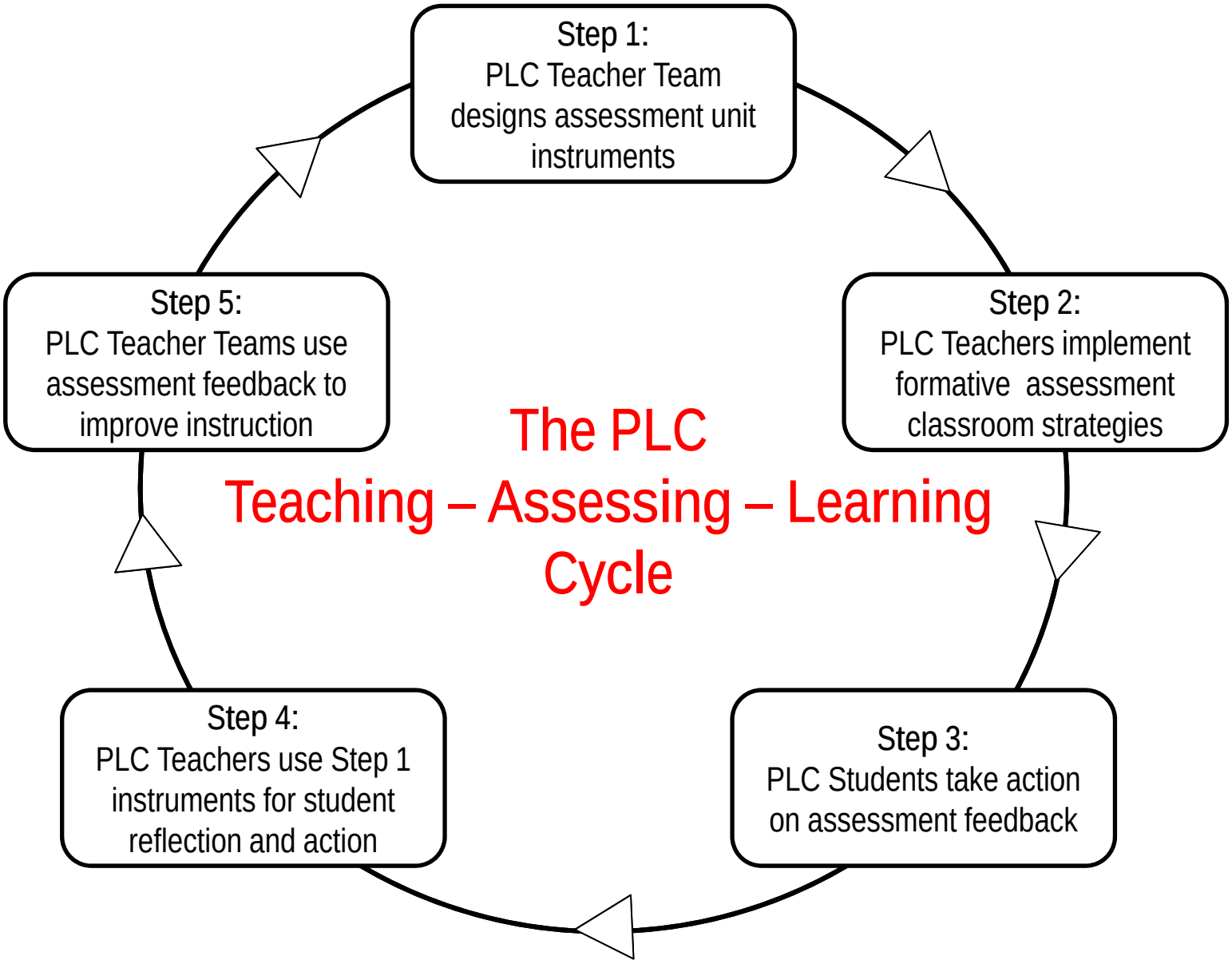
# Analyzing Assessment Tasks

To what extent does the assessment:

- Provide valid information about students' knowledge?
- Provide information about students' conceptual understanding?
- Provide information about students' proficiency in the standards for mathematical practice?

# Common Assessment Planning Process

- Plan
- Develop
- Critique
- Administer and Score
- Revise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# Collaborative Team Actions: Assessment Instruments and Tools

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*Few interventions have the same level of impact as assessment for learning. The most intriguing result is that while all students show achievement gains, the largest gains accrue to the lowest achievers.*

Stiggins, et al. (2006, p. 37)

# Collaboratively Analyzing Student Performance

- Task analysis
- Gathering and analyzing evidence of students thinking, understandings, and misconceptions.

# Analyzing Students' Work

Goal: Diagnose what students thought, could do, where they had errors or incomplete understanding.

- Identify common understandings, common errors, misunderstandings or misconceptions.
- Consider strengths and weaknesses:
  - What are the implications for future instruction?
  - What specific instruction or experiences will you design for students?

# Effective Intervention

- Is mandatory, not optional (i.e., scheduled during the school day whenever possible);
- Is based on constant monitoring of students' progress, as determined from the results of formative and summative assessment, ensuring that students get support as quickly as possible;
- Attends to conceptual understanding as well as procedural fluency; and
- Allows for flexible movement in and out of the intervention as students need it.

(Kanold and Larson 2012)

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# Effective Intervention

- Additional intervention periods
- During regular instructional time
  - Flexible groups across teachers for intervention; heterogeneous core instruction
  - Re-engagment lessons

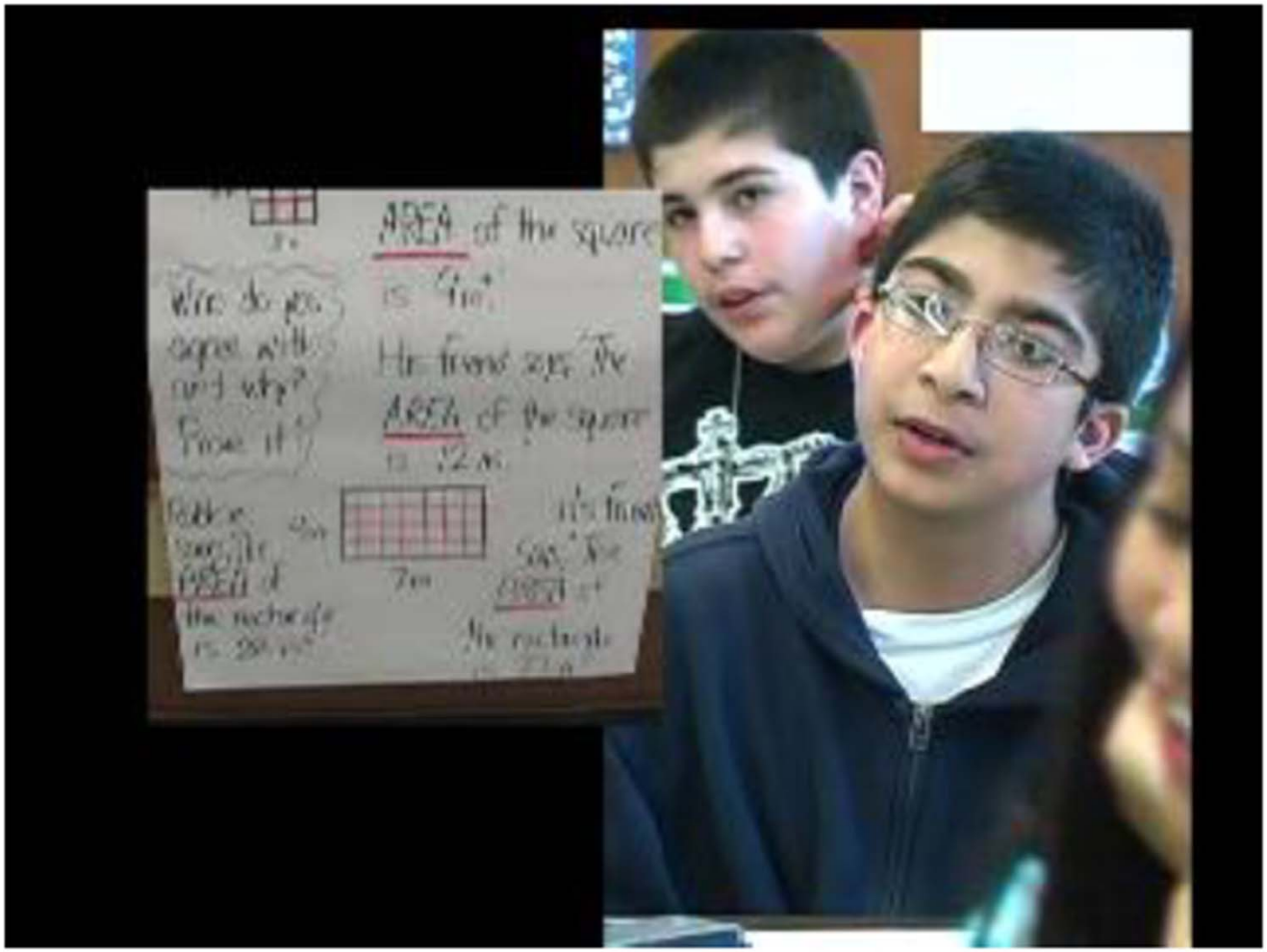
# Traditionally Teacher Choose One of Three Options

- 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 moves on.
- Feeling the pressure of the over-packed curriculum, the teacher ventures on to the next topic.

David Foster, 2010

# Re-engagement:

*Completing the Formative Assessment Cycle*




David Foster, 2010

# Re-teaching vs. Re-engagement

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

- Revisit student thinking
- Address conceptual understanding
- Examine task from different perspective(s)
- Critique student approaches/solutions to make connections
- The entire class is engaged in the math

David Foster, 2010

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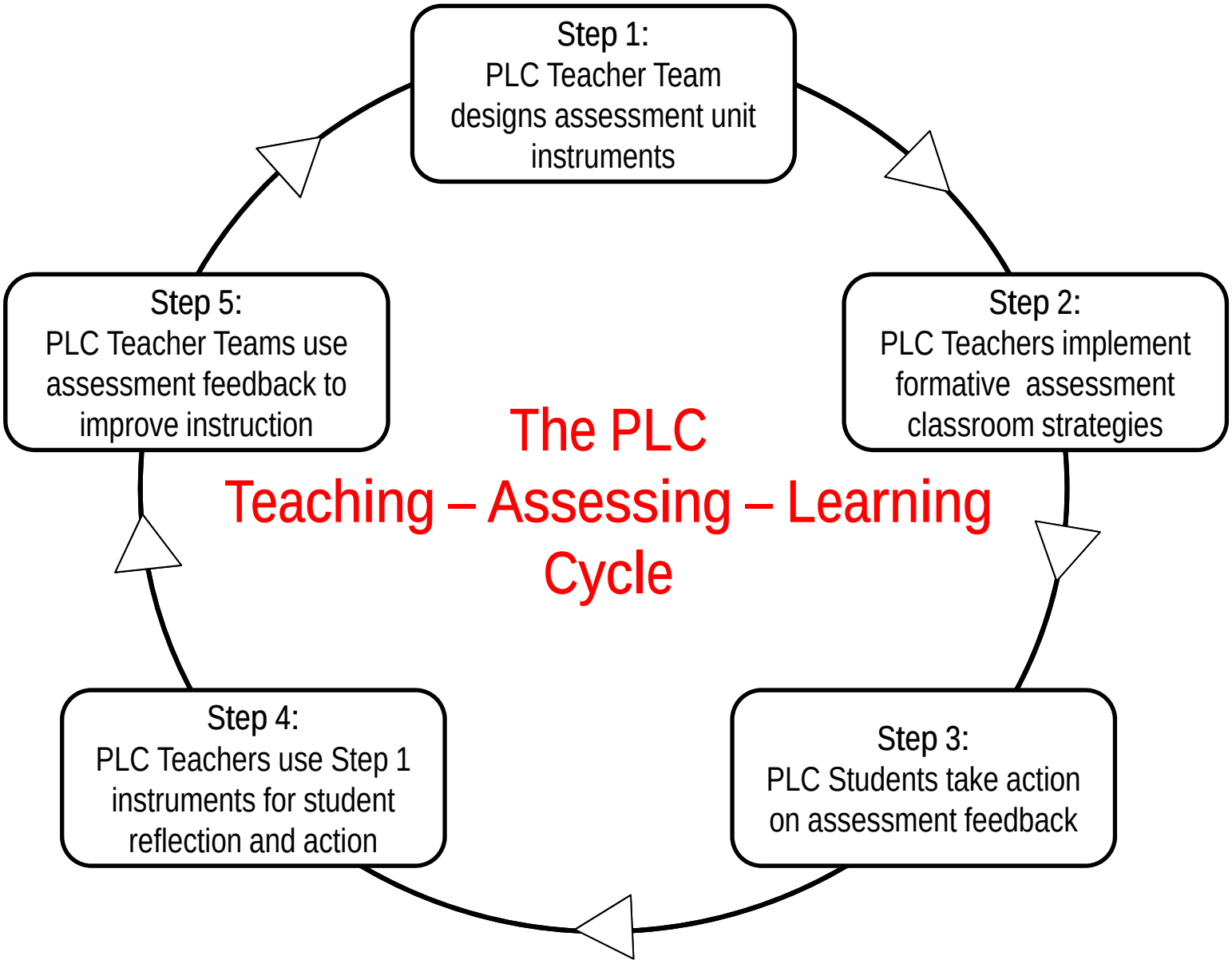
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# Shifts in Assessment

- Multifaceted process; emphasis on formative assessment
- Assess conceptual understanding and the Standards for Mathematical Practice as well as procedural fluency and application
- Emphasis on students' thinking rather than only on correct answers

# Collaboration Team Work

- An examination and prioritization of the mathematics content and mathematics practices students are to learn.
- The development and use of common assessments to determine if students have learned the agreed-on content and related mathematical practices.
- The use of data to drive continuous reflection and instructional decisions.
- The setting of both long-term and short-term instructional goals.
- Development of action plans to implement when students demonstrate they have or have not attained the standards.
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Principles to Actions, pp. 103-104

post-gazette.com
Pittsburgh Post-Gazette

# Why I won't let my son take the PSSA

March 31, 2013 12:10 am
By Kathy M. Newman /

I am an English professor. So you can imagine how my pride was hurt when my 9-year-old son Jacob started bringing home low scores on his practice reading tests for the Pennsylvania System of School Assessment.

My husband and I have been helping Jacob with his test-prep reading homework every weeknight this year, and it has been a grim slog. At times I have found myself getting angry when Jacob has fidgeted, or when he has had trouble focusing. Sometimes I have gotten angry when he simply hasn't been able to answer the questions.

Then one day this March it dawned on me. I am getting angry at my son about a test. A test that I do not like. A "high-stakes" test that will put so much pressure on Jacob that it probably will not reflect his true abilities. I also realized something else: Jacob does not love to read.

After doing some research and talking with other parents, my husband and I decided to "opt out" Jacob from the PSSA tests. We are opting him out because we do not like what high-stakes tests are doing to Jacob, to our family, to his teachers, to his school and, ultimately, to our entire education system.

| Beliefs about mathematics assessment | |
|---|---|
| **Unproductive beliefs** | **Productive beliefs** |
| The primary purpose of assessment is accountability for students through report card marks or grades. | The primary purpose of assessment is to inform and improve the teaching and learning of mathematics. |
| Assessment in the classroom is an interruption of the instructional process. | Assessment is an ongoing process that is embedded in instruction to support student learning and make adjustments to instruction. |
| Only multiple-choice and other "objective" paper-and-pencil tests can measure mathematical knowledge reliably and accurately. | Mathematical understanding and processes can be measured through the use of a variety of assessment strategies and tasks. |
| A single assessment can be used to make important decisions about students and teachers. | Multiple data sources are needed to provide an accurate picture of teacher and student performance. |
| Assessment is something that is done to students. | Assessment is a process that should help students become better judges of their own work, assist them in recognizing high-quality work when they produce it, and support them in using evidence to advance their own learning. |
| Stopping teaching to review and take practice tests improves students' performance on high-stakes tests. | Ongoing review and distributed practice within effective instruction are productive test preparation strategies. |

# What about “Test-Prep”?

Too often, teachers are putting regular instruction “on hold” to spend class time practicing test questions. While on the surface this may appear to make sense, research indicates just the opposite—

***test scores are lower in schools where teachers spend large amounts of time on test prep*.**

(Allensworth, Correa, & Ponisciak, 2008)

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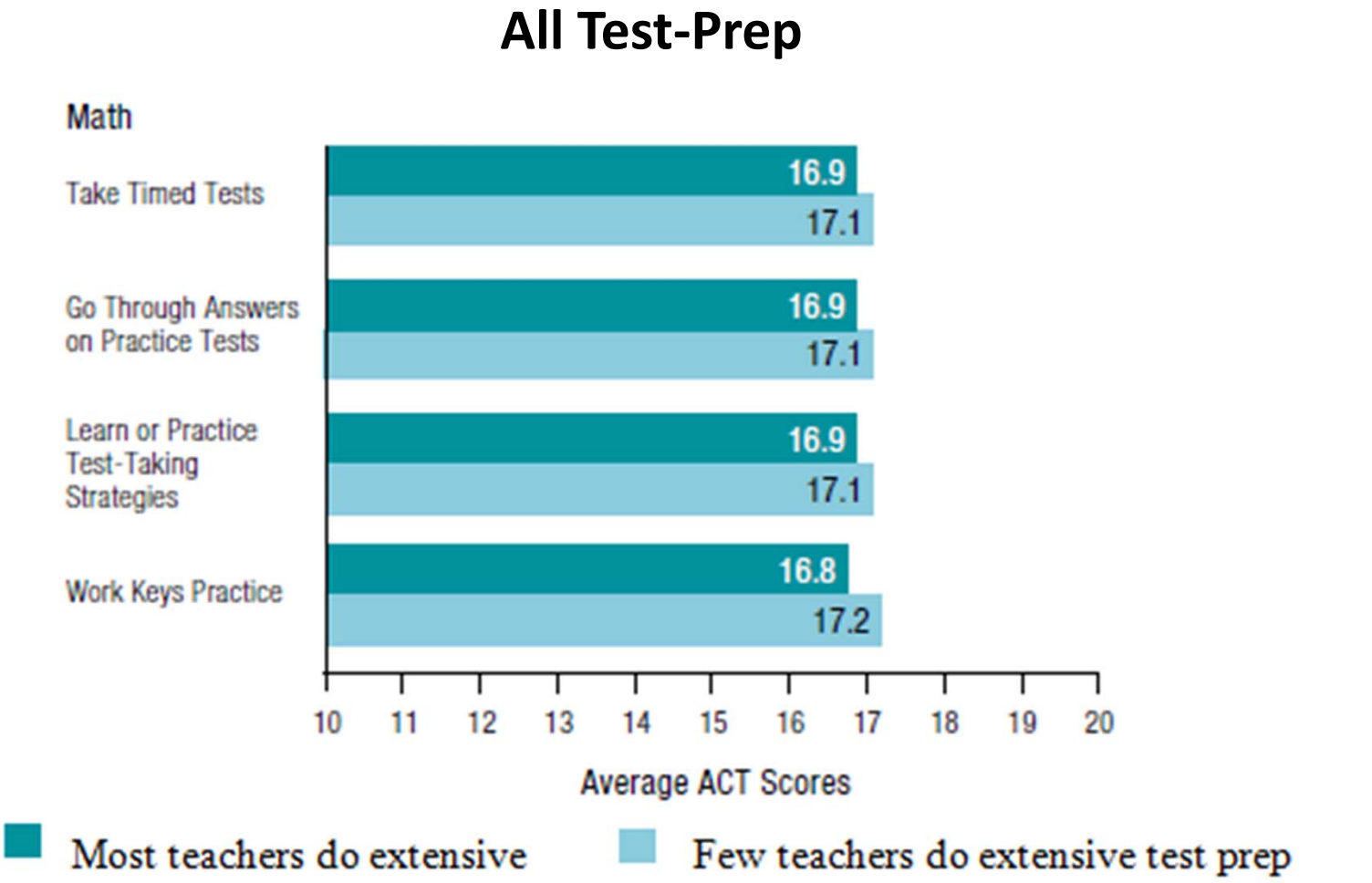
# Intensive Test Prep Produces the Same or Lower Scores as Little or No Test Prep

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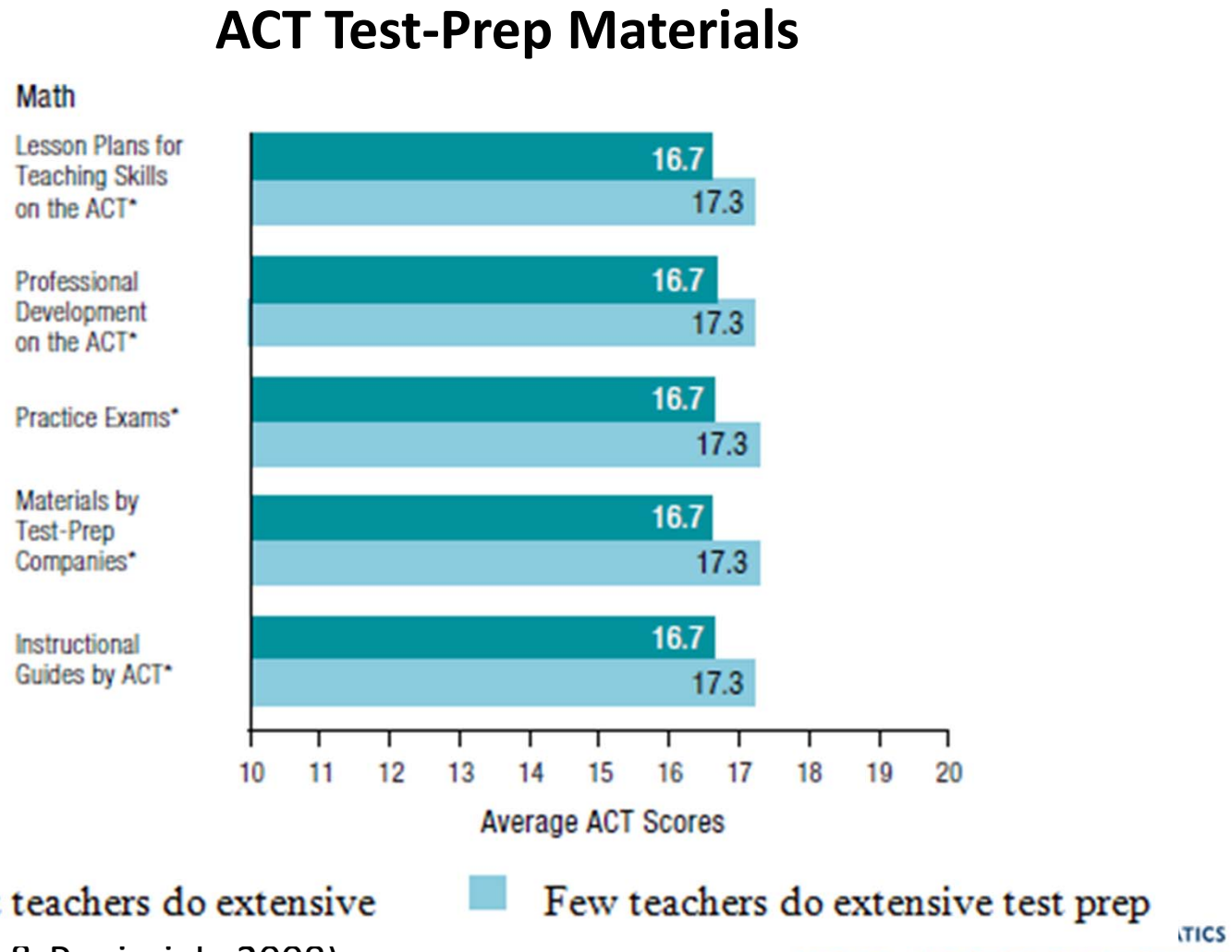


(Allensworth, Correa, & Ponisciak, 2008)

# Effective Assessment Practice
# Ongoing Review and Practice

Providing students with periodic opportunities to practice using concepts and skills, along with feedback about their performance, helps students solidify their knowledge and promotes retention, reflection, generalization, and transfer of knowledge and skill.

IES Practice Guide, 2007

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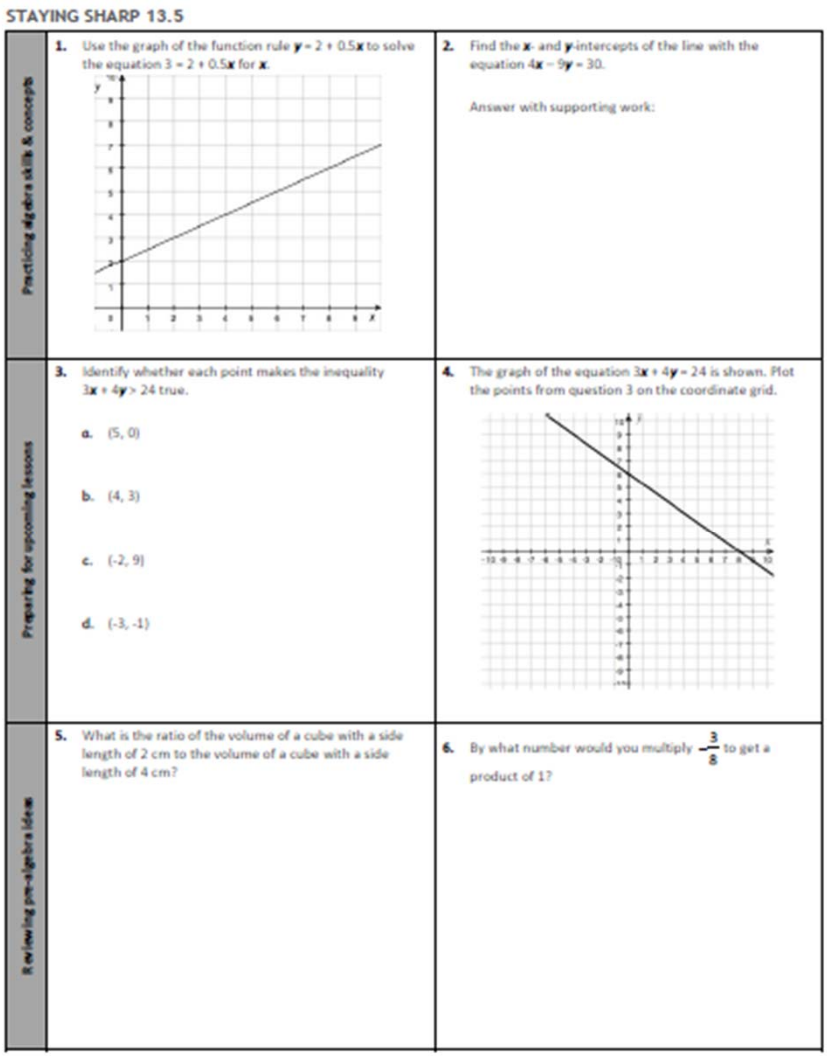
# Distributed Practice

- Openers
- Homework
- Incorporate into instructional and/or assessment tasks



STAYING SHARP 13.5

**Practicing algebra skills & concepts**

**1.** Use the graph of the function rule $y = 2 + 0.5x$ to solve the equation $3 = 2 + 0.5x$ for $x$.

**2.** Find the $x$- and $y$-intercepts of the line with the equation $4x - 9y = 30$.

Answer with supporting work:

**Preparing for upcoming lessons**

**3.** Identify whether each point makes the inequality $3x + 4y > 24$ true.

a. (5, 0)

b. (4, 3)

c. (-2, 9)

d. (-3, -1)

**4.** The graph of the equation $3x + 4y = 24$ is shown. Plot the points from question 3 on the coordinate grid.

**Reviewing pre-algebra ideas**

**5.** What is the ratio of the volume of a cube with a side length of 2 cm to the volume of a cube with a side length of 4 cm?

**6.** By what number would you multiply $-\frac{3}{8}$ to get a product of 1?

# Good Instruction is the Best Test-Prep

- Students acquire conceptual knowledge as well as skills to enable them to organize their knowledge, transfer knowledge to new situations, and acquire new knowledge.
- Students engage with challenging tasks that involve active meaning-making.
- Students know what is expected

Hiebert & Grouws, 2007

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# Promoting Productive Struggle

..\..\..\..\..\Videos\Carol Dweck The Effect of Praise on Mindsets.mov

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# Students' Beliefs about Their Intelligence Affect Their Academic Achievement

- Fixed mindset:
  - Avoid learning situations if they might make mistakes
  - Try to hide, rather than fix, mistakes or deficiencies
  - Decrease effort when confronted with challenge
- Growth mindset:
  - Work to correct mistakes and deficiencies
  - View effort as positive; increase effort when challenged

Dweck, 2007

# Students' Beliefs about Their Intelligence Affect Their Academic Achievement

When confronted with challenging school transitions or courses, students with growth mindsets outperform those with fixed mindsets, even when they enter with equal skills and knowledge.

Dweck, 2007

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# Students Can Develop Growth Mindsets

- Teacher praise influences mindsets
  - Fixed: Praise refers to intelligence
  - Growth: Praise refers to effort, engagement, perseverance
- Explicit instruction about the brain, its function, and that intellectual development is the result of effort and learning has increased students' achievement in middle school mathematics.
- Reading stories of struggle by successful individuals can promote a growth mindset

# "Effort Praise" Promotes Growth Mindsets

*"You really studied for your English test, and your improvement shows it. You read the material over several times, outlined it, and tested yourself on it. That really worked!"*

*"I like the way you tried all kinds of strategies on that math problem until you finally got it."*

*"It was a long, hard assignment, but you stuck to it and got it done. You stayed at your desk, kept up your concentration, and kept working. That's great!"*

*"I like that you took on that challenging project for your science class. It will take a lot of work—doing the research, designing the machine, buying the parts, and building it. You're going to learn a lot of great things."*

Dweck, 2007

# "Effort Praise" Promotes Growth Mindsets

What about a student who gets an *A* without trying?

- *"All right, that was too easy for you. Let's do something more challenging that you can learn from."*
- What about a student who works hard and *doesn't* do well?
- *"I liked the effort you put in. Let's work together some more and figure out what you don't understand."*

Dweck, 2007

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# Start Small, Build Momentum, Persevere

The process of creating a new cultural norm characterized by professional collaboration, openness of practice, and continual learning and improvement can begin with a single team of grade level or subject-based mathematics teachers making the commitment to collaborate on a single lesson plan.

Principles to Actions, p. 207

# Thank You!

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# Words To Live By

http://www.youtube.com/watch?v=iaOoxhI5iEE

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