

Common Core State Standards: Implications for Instruction

W. Gary Martin
Leischuck Endowed Professor
of Mathematics Education
Auburn University
wgarymartin@auburn.edu

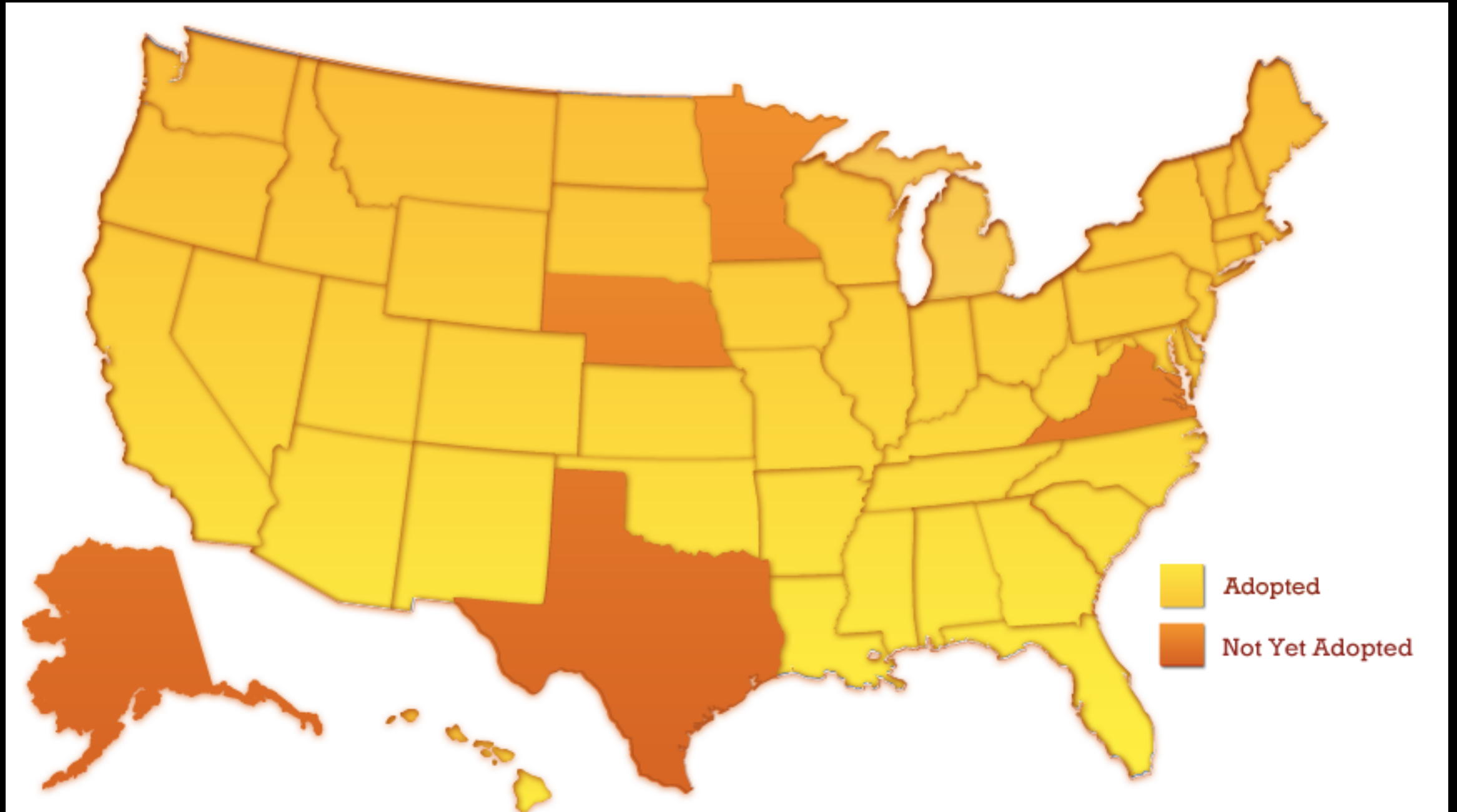
Goal of Session

- To introduce you to what is happening in school mathematics in Alabama (and across the nation)
- To consider the implications of the new standards for the courses you teach
- To think about effective ways of helping students progress mathematically

Common Core State Standards for Mathematics

- August 2009 -- Initial framework released
- October 2009 -- Writing groups formed
- March 2010 -- Draft released
- June 2010 -- Final standards released
- November 2010 -- Adopted by Alabama
 - “Alabama College and Career Ready Standards”

Adopted by 45 States



Description

- The standards are informed by the highest, most effective models from states across the country and countries around the world, and provide teachers and parents with a common understanding of what students are expected to learn.
- Consistent standards will provide appropriate benchmarks for all students, regardless of where they live.
- These standards define the knowledge and skills students should have within their K-12 education careers so that they will graduate high school able to succeed in entry-level, credit-bearing academic college courses and in workforce training programs.

Content Standards

“What students should know and be able to do”

- Grade (K-8) or Conceptual Category (9-12)
 - Domains (around 5 per grade)
 - Clusters (1-5 per domain)
 - Standards (1-5+ per cluster)

Grade 6

Grade

Expressions and Equations

Domain

Reason about and solve one-variable equations and inequalities.

Cluster

5. Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.

Standard

Functions

Conceptual
Category

Interpreting Functions

Domain

Interpret functions that arise in applications in terms of the context

Cluster

4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

Standard

Review the Two Sample Standards

- What do you notice?

General Changes in Approach

- The content standards include a focus on developing conceptual understanding as well as procedural facility.
- That is, knowing “how” is not sufficient.
- Include significant attention to applications and modeling.
- Incorporate appropriate use of technology.

Changes in Content

- Topics in grades K-5 are often one or more grades earlier.
- Increased emphasis on algebra in grades 6-8; includes much of the traditional Algebra I course.
- Increased emphasis on statistics and data analysis in grades 6-12.

Changes in Content: High School

- Transformational approach to geometry
- Algebra and Functions as separate (but related) conceptual categories
- Focus on reasoning in algebra, not just following rules
- Focus on modeling and applications

Sample Problem

www.illustrativemath.org

The population of a country is initially 2 million people and is increasing at 4% per year. The country's annual food supply is initially adequate for 4 million people and is increasing at a constant rate adequate for an additional 0.5 million people per year.

- a. Based on these assumptions, in approximately what year will this country first experience shortages of food?
- b. If the country doubled its initial food supply and maintained a constant rate of increase in the supply adequate for an additional 0.5 million people per year, would shortages still occur? In approximately which year?
- c. If the country doubled the rate at which its food supply increases, in addition to doubling its initial food supply, would shortages still occur?

Discuss

- Focus on part (a) -- How would you expect a high school student to solve this problem?
- Focus on parts (b), (c) -- What is the objective of these questions?

(FUNCTIONS) Construct and compare linear, quadratic, and exponential models and solve problems.

- Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

(ALGEBRA) Represent and solve equations and inequalities graphically.

- Explain why the x -coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$;
- find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations.
- Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.* [A-REI.11]

(FUNCTIONS) Construct and compare linear, quadratic, and exponential models and solve problems.

- Observe, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

The Most Significant Change:

*The Standards for
Mathematical Practice*

Standards for Mathematical Practice

- Describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.
- Build on “process standards” (NCTM) and “mathematical proficiencies” (NRC)
- They are standards!
- Note -- these are not separate topics to be taught.
 - Rather, they are meant to be embedded within the content that is taught.
 - The Practices also support the development of conceptual understanding.

Standards for Mathematical Practice

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.

Discuss

- What do you notice about these standards?
- How will teachers help their students achieve these standards?

What are the implications for teaching introductory courses?

1. Students are beginning to have different kinds of experiences in K-12.
2. These experiences are also worthwhile for students in higher education!

Important Note

- Students cannot achieve these standards by watching someone else do all the thinking.
- They need to have opportunities to develop their own mathematical thinking.

“Mathematics is NOT a spectator sport!”

“Teaching via Problem Solving”

- Give students an interesting task to think about on their own.
- Allow them to share their ideas about the task.
- Build on their thinking to develop the mathematical concepts you are teaching.

For More Information...

- Math/Math Education Seminar meets bi-weekly each semester.

April 11, 4:00 PM

April 25, 4:00 PM

Haley Center 2456

- Web links (see handout)
- Contact wgarymartin@auburn.edu