California Math Teacher Preparation and the Common Core

Eric Hsu
Director, Center for Science and Mathematics Education
Professor, Mathematics

Judy Kysh
Professor, Mathematics and Secondary Education
1. The Standards Have Come To Us
2. Changes in CA Teacher Curriculum
3. A Sample Task
4. Discussion
5. Thanks
The Standards Have Come To Us
Elementary and Secondary Math Teacher
Deep Curriculum

• Math can make sense.
• Math can convince others.
• Math is about inventiveness and exploration, as well as precision.
  ◦ convergent AND divergent thinking
• Math facts can be deduced, not just recalled.
• Math algorithms can/should be explained.
• Know the feeling of math making sense and not making sense.
  ◦ (So you know when to get help.)
Elementary and Secondary Math Teacher
Deep Curriculum

- Team problem solving
- Non-routine problems
- Representations: symbolic, physical, visual, numerical, verbal
- Non-standard algorithms
- Whole class argumentation
Alignment with Old Standards

• Old CA Standards Strands
  o Number Sense
  o Algebra and Functions
  o Measurement and Geometry
  o Statistics, Data Analysis, and Probability
  o **Mathematical Reasoning** (a chapter!)
    ▪ e.g. MR7.1.0. 'Students make decisions about how to approach problems’

• Common Core Standards
  o Standards for Mathematical Practice, better aligned!
(Practices) Standards Have Come To Us

- Make sense of problems and **persevere in solving them**.
- **Use appropriate tools strategically.**
- Reason abstractly and quantitatively.
- **Construct viable arguments** and critique the reasoning of others.
- **Model with mathematics.**
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.
(Practices) Standards Have Come To Us

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

- **Non-routine problems**
- **Non-standard algorithms**
- **Team problem solving**
- **Group and whole class argumentation**
- **Representations and Models**
  - symbolic, physical, visual, numerical, verbal
(2)

Changes to Teacher Curriculum
Elementary Teacher Coursework (pre-NCLB)

Waiver Program

• Math 165: Number System
• Math 565: Geometry, Measurement, and Prob

Encouraged

• Math 265: Advanced Number Systems (%, Z)

Delightful Bonus

• Math 575, 576, 577, 578: MS & HS Math

Credential Program

• EED 784: Math Curriculum & Instruction
Elementary Teacher Coursework (post-NCLB)

Waiver Program **Delightful Bonus**

- Math 165: Number System
- Math 565: Geometry, Measurement, and Prob

Encouraged **Not Offered**

- Math 265: Advanced Number Systems (%, Z)

**Delightful Bonus: Unicorn-like Rarity**

- Math 575, 576, 577, 578: MS & HS Math

Credential Program

- EED 784: Math Curriculum & Instruction
Common Core Changes in the Elementary Math Curriculum

- Practices Anxiety — well covered
- Number line representation of numbers
- Part-Whole and Unit Fractions as foundational
  - \( \frac{5}{6} \) as 5 one-sixths
- Proportional Reasoning
  - One quantity is a constant multiple of another.
  - Ratios, proportions, rate, percent, scale, slope, geometric similarity, probability…
- (and the reasoning and modeling practices, etc.)
## Secondary Math Teacher Coursework

**In CA, a Full Math Major (Waiver Program)**

<table>
<thead>
<tr>
<th>Math Course</th>
<th>Math Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 226: Calculus I</td>
<td>MATH 300: History of Mathematics</td>
</tr>
<tr>
<td>MATH 227: Calculus II</td>
<td>MATH 309: Computation in Mathematics</td>
</tr>
<tr>
<td>MATH 228: Calculus III</td>
<td>MATH 310: Elementary Number Theory</td>
</tr>
<tr>
<td>MATH 301: Proof</td>
<td>MATH 324: Probability and Statistics</td>
</tr>
<tr>
<td>MATH 325: Linear Algebra</td>
<td>MATH 350: Geometry</td>
</tr>
<tr>
<td>MATH 335: Modern Algebra</td>
<td><strong>MATH 375: Early Field Experience</strong></td>
</tr>
<tr>
<td>MATH 370: Real Analysis I</td>
<td><strong>MATH 475: Capstone Course</strong></td>
</tr>
</tbody>
</table>

*plus in credential program…*

| SED 759: Math Curriculum & Instruction | SED 769: Math Curriculum & Instruction |
Teacher Fellows: Professional Community & Service Learning
Teacher Fellows (2008-2013)

70+ 158
2013 Fellows Total Fellows

17,000 hrs $382,000
total community service stipends from university,
25+ $285,000
schools served Federal, private donations

15 school districts served

15 school districts served
Triple the Math Teaching Majors

“A model for the state and nation. An outstanding program to be adopted by other campuses, that warrants scale up system-wide.”

– CSU Chancellor’s Office
# Secondary Math Teacher Coursework

## A Full Math Major (Waiver Program)

<table>
<thead>
<tr>
<th>Math Course</th>
<th>Math Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 226: Calculus I</td>
<td>MATH 300: History of Mathematics</td>
</tr>
<tr>
<td>MATH 227: Calculus II</td>
<td>MATH 309: Computation in Mathematics</td>
</tr>
<tr>
<td>MATH 228: Calculus III</td>
<td>MATH 310: Elementary Number Theory</td>
</tr>
<tr>
<td>MATH 301: Proof</td>
<td>MATH 324: Probability and Statistics</td>
</tr>
<tr>
<td>MATH 325: Linear Algebra</td>
<td>MATH 350: Geometry</td>
</tr>
<tr>
<td>MATH 335: Modern Algebra</td>
<td>MATH 375: Early Field Experience</td>
</tr>
<tr>
<td>MATH 370: Real Analysis I</td>
<td>MATH 475: Capstone Course</td>
</tr>
</tbody>
</table>

*plus in credential program…*

| SED 759: Math Curriculum & Instruction | SED 769: Math Curriculum & Instruction |
- **Added**
  - **Modeling, proportional reasoning**
    - More probability, expected value
    - More stats: p-values, confidence intervals…
    - Transformational Geometry
- **Removed**
  - History of Mathematics
  - Cross Products
  - non-Euclidean Geometry
- **Subtle Changes**
  - ‘Know’ to ‘Demonstrate knowledge of’
  - ‘Know and apply’ to ‘Apply’, ‘Justify Steps’
Standards on Paper vs. Standards in Life

• Integrated Courses
  o in theory, a need for powerful inter-connections between algebra and geometry

• Smarter Balanced Assessments
  o who knows?
  o Computers, free response, non-routine problems
  o High stakes warp the curriculum
A Sample Task
The Difference of Squares

Some numbers can be expressed as the difference of two squares. For example:

\[ 8 = 3^2 - 1^2 \]

Sometimes there are several ways to do this:

\[ 15 = 8^2 - 7^2 \text{ or } 15 = 4^2 - 1^2 \]

**Investigate.** Can any whole number \( N \) be written as the difference of two squares?

You might try 43, 99, or 60 as a difference of two squares? How about 26?

Generalize and justify your generalizations.
A Problem Protocol (Curriculum & Instruction)

• Restate the essence of the problem.

• Describe your thinking and reasoning as you worked on the problem and clearly show your solution process.

• Justify your solution (or progress so far with the problem).

• Reflect on the strategies you used. What did you learn?

• What mathematics would students practice or learn?
The Standards Have Come To Us

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

- Non-routine problems
- Non-standard algorithms
- Team problem solving
- Group and whole class argumentation
- **Representations and Models**
  - symbolic, physical, visual, numerical, verbal
Discussion
(5)

Thanks to NSF

CAREER & MSP