The Changing Math Wars In the USA

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What right do I have to talk about math education?

- I'm a research mathematician, so what?
- We teach 13th grade for a living!
- Sort of.
- In fact, 73% of college teaching is K-12 math
- We are really K-12 teachers, not 13th grade!
- 2.7% of our teaching is above calculus
- And, I'm also a Professor of Education

The math wars of the past

- Both sides often think it is about teaching
- The reform crowd says we “traditionalists” want rote learning.
- Yeah, right. Mathematicians, scientists, and engineers don’t want students to understand the math?
- I don’t think so!

Some Quotes

- Teachers of arithmetic now see that former reliance upon drill, upon countless repetitions, for learning the basic facts and computational techniques of arithmetic was futile.
- Teachers are coming to believe that pupils can and should understand their arithmetic operations.

Where from?

- The teacher's edition of 5th grade math
- From my 1956 5th grade class
- No one alive today should even remember rote learning!
- If small town Kansas in 1956 wasn't traditional
- Traditional never existed

If not teaching, what is it?

Content!

Who controls what?

- The K-12 establishment controls all aspects of K-12 math and does not have to listen to colleges.
- They even get to decide if they are successful or not.
- College math folks control colleges and can put anyone they want in remedial math.
- Not much feedback.

Inquiry based math teaching

- No existing programs cover the right content
- Of course, they don’t agree with us on what the right content is.
- The fight in the USA math wars has been about what to teach, not how to teach.
- The compromise solution:
- The Common Core State Standards (CCSS)

The Common Core State Standards

- Almost all states (well over 40) have adopted the CCSS for mathematics.
- It is a compromise document
- A handful of states were better
- But CCSS is vastly better than the majority of states!
- (You can’t imagine how bad some states were.)

Some compromises

- By end of grade 2, know from memory all sums of two one-digit numbers
- Nothing similar for subtraction
- One for the facts folks
- One for the anti-fact folks
- Same with multiplication and division.

Standard algorithms

- Grade 4: Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations.
- Translation to reform math:
- Do any old thing you want to multiply
- Grade 5: Fluently multiply multi-digit whole numbers using the standard algorithm.
- One for us and one for them

Algorithms before Common Core

- In 2005 there were 3 states that had the standard algorithm for multiplying whole numbers in their standards.
- In 2010 it was up to 7 states.
- Now, with Common Core, we have 44.
- 37 for the good guys.

Geometry

- No axioms or postulates
- Similarity defined by transformations
- A prize to anyone who can show me a high school geometry text (in English) that is reasonably mathematically rigorous and defines similarity using transformations.

Common Core: Are we done now?

- No.
- 75 pages of math content
- Referred to as “that rote stuff”
- 3 pages of Mathematical Practices
- The “real” math.

The Mathematical Practices

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.

And two more

7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Each has a whole paragraph, and, really, they aren’t that bad.

They are just unteachable and untestable.

They aren’t actually standards.

The transition to Common Core

- It is all about Mathematical Practices
- States have summer programs for teachers about math practices
- NEVER ABOUT FRACTIONS!
- Common Core does fractions really well.

Worse: Assessments

- Two consortia for assessments
- Each with 20+ states
- Each now has a “framework” between the standards and the assessments.
- Both agree to do the impossible
- But one is “good” and one is “bad.”

The Smarter Balanced Assessment Consortium

- The bad one. No quotes need.
- SBAC divides problems into 4 types
- Each type is justified by the Mathematical Practices
- It gets worse, but first:
- The 4 types of problems

- Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.
- Students can frame and solve a range of complex problems in pure and applied mathematics.
- Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.
- Students can analyze complex, real-world scenarios and can use mathematical models to interpret and solve problems.

Problems I have with this

- No mention of content, like, uh,
- Fractions
- Algebra
- Geometry
- It is all about thinking.
- Who can be against thinking?
- I am.

My motto

Content you will get you through times of no critical thinking better than critical thinking will get you through times of no content.

(Ripped off from the fabulous furry freak brothers.)

Communication

- # 1 and # 3 were all about communication.
- Communication is independent of math understanding.
- Forced to explain what we were thinking (i.e. the obvious) when we were 10 years old, we would not have become mathematicians.
- Because we were “bad” at math.

Deep critical thinking

- SBAC # 2, 3, and 4 require such deep critical thinking that they will use “content first taught in earlier grades.”
- Let’s think critically (and deeply) about that.
- If you were a teacher, and your job and your salary depended on the test scores of your students, what would you teach?
- This year’s material or last year’s material?

Textbook writers

- What would you write?
- You'd use last year's content to solve complex problems all year, and ignore this year's content?!
- How would you write next year's textbook?
- The math wars are not over,
- They are just getting weirder and weirder.

- The average 4th grader in the USA will go to college and drop out.
- We have a choice.
- We can prepare kids for dropping out
- Or prepare them to not drop out
- The “opposition” can’t connect K-7 math with anything needed in college, so
- They prepare kids to drop out

How to prepare kids to drop out

There will always be people who think that calculators work just fine and there is no need to teach much arithmetic, thus making career decisions for 4^{th} graders that the students should make for themselves in college.

- There will always be the anti-memorization crowd who think that learning the multiplication facts to the point of instant recall is bad for a student, perhaps believing that it means students can no longer understand them. Of course this permanently slows students down, plus, it requires students to think about 3rd grade mathematics when they are trying to solve a college level problem.

- There will always be the anti-standard algorithms people. Some seem to believe it is easier to teach “high level critical thinking” than it is to teach the standard algorithms with understanding. The standard algorithms for adding, subtracting, multiplying and dividing whole numbers are the only rich, powerful, beautiful theorems you can teach elementary school kids, and to deny kids these theorems is to leave kids unprepared. Avoiding hard mathematics with young students does not prepare them for hard mathematics when they are older.

- There will always be people who believe you do not understand mathematics if you cannot write a coherent essay about how you solved a problem.

- There will always be people who think that you must be able to solve problems in multiple ways. This is probably similar to thinking it is important to teach creativity in mathematics in elementary school, as if such a thing were possible. Forget creativity, the truly rare student is the one who can solve straightforward problems in a straightforward way.

- There will always be people who think that statistics and probability are more important than arithmetic and algebra, despite the fact that you can’t do statistics and probability without arithmetic and algebra and that you will never see a question about statistics or probability on a college placement exam, thus making statistics and probability irrelevant for college preparation.

- There will always be people who think that teaching kids to “think like a mathematician” -- whether they have met a mathematician or not -- can be done independently of content.

- There will always be people who think that teaching kids about geometric slides, flips and turns is just as important as teaching them arithmetic. It isn't. Ask any college math teacher.

Thank you, The End