What Does a "Complete Balanced Curriculum" Really Mean?

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1. Math Framework (2005)
California Department of Education

Goals for Teachers

(#2) Provide an instructional program that preserves the balance of computational and procedural skills, conceptual understanding and problem solving.

2. **Goals for students**

(#1) *Develop fluency in basic computational and procedural skills, an understanding of mathematical concepts, and the ability to use mathematical reasoning to solve mathematical problems...*
(#2) *Communicate precisely...*
(#3) *Develop logical thinking...*

Note: Goals # 2 and 3 are unrelated to anything in teacher goals.

3. Teacher #2

Provide an instructional program that preserves the balance ***of computational and procedural skills****, conceptual understanding and problem solving.*

Student #1

Develop fluency ***in basic computational and procedural skills****, an understanding of mathematical concepts, and the ability to use mathematical reasoning*

Note primacy of skill acquisition.

4. Data points

Framework cites a study by Siegler and Sterns (1998) who did a microgenic study of 31 second graders to support case for practice leading to understanding.

German study about TIMSS results (1998) of 100 classrooms (about 3000 students) showed that for eighth graders lots of routine practice was a determining factor for classes that learned LESS.

5. What is math we want students to learn?
   What is math?

6. How do we know they know it?

If we are interested in

- Basic skills
- Conceptual understanding
- Problem-solving
- Logical thinking

How do we test each of them?
Which are easy and cheap to test?
Which are hard and expensive?
Which of the aspects will get tested?

7. When do we want them to know it?

Some states test in the fall.
Montessori schools don't teach formal arithmetic until grade four.
Finnish students don't enter school until age 7 and there is a debate if this is too young.

8. My answers.

1. Focus needs to be on ***long-term learning and transfer***.

   Not much point in teaching a topic unless the students can understand it well enough to use it later.

2. A lot of math needs "sinking in" time—especially concept development.

   Practice and thinking needs to be spread out for effective learning.

9. Time is most important constraint

Have only so much time in any math period to teach skills, concepts, problem solving and logical thinking. So, as far as possible, every task must do more than one thing. The various pieces can be tied together to support mutual learning.

10. Math is *sense-making*.

(Alan Schoenfeld)

Students need to get the depth of concepts if they are ever to be able to use them properly.

Examples.
What is a fraction?
Why can we write the same fraction in more than one way?

What is a variable?
How can a variable sometimes stand for a specific number [3x+2=17] and sometimes for any number
[2(x+3) = 2x+6]?

11. **Problem solving can help with the issue of tying the curriculum goals together.**

Problem solving BOTH a means of thinking and learning—and an end.

12. What can problem solving do for student learning?

- A good problem sets a context for doing math where the mathematics can connect to intuition so that both the answer and process will make sense.
- Solving problems helps develop logical reasoning.

Depending on the complexity of the situation, a problem can develop the need for an algorithm.

13. Another gigantic advantage

A good problem-solver has learned a useful way to think about the world.

What is the situation?
What is the goal?
How do we get from one to the other?

If someone has learned to reason in easy situations—and there are no easier situations in which to reason than math—then they have a chance to reason in more complex situations.

14. Balancing computational and procedural skills, conceptual understanding, problem solving and logical thinking.

Balance means that the four components ***support one another*** for long-term learning and application both in school
(eg chemistry) and out of school
(Which loan is better?).

I believe that well-chosen problems can not only help students see the connections, but motivate them to try to make sense of the math.