What do teachers need to know to teach mathematics well?

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QuickTime™ and a decompressor are needed to see this picture.
It is about the students and evidence that they are learning.
What do teachers need to know to teach well?

and/or

How should teachers come to know?
Content knowledge

- But not “everything”
- Think deeply about simple things
- Not all math is equally important
Curriculum trajectories

What comes before and what follows

“learning lines”
Look for and make use of structure

- Look closely to discern a structure
- Step back for an overview and shift to a new perspective
Arithmetic to algebra: “Met-befores”
(Tall, 2004)

Place value

2x^2 + 3x + 5
2x + 3x
2x^3 + 3x

2 \cdot 10^2 + 3 \cdot 10 + 5
2 \cdot 10 + 3 \cdot 10
2 \cdot 10^2 + 3 \cdot 10

1 + 0.2 + 0.03 + 0.45 = 1 + \frac{2}{10} + \frac{3}{100} + \frac{45}{100}
The distributive property

\((22)(37) = 22(30) + 22(7)\)

\((x+3)(x+5) = x(x+5) + 3(x+5)\)
Learn math by doing math

And talking about it.
Construct viable arguments & critique the reasoning of others

- make conjectures and build a logical progression of ideas
- evaluate arguments, decide whether they make sense, and ask useful questions to clarify or improve the arguments
- distinguish correct reasoning from that which is flawed and explain any flaws

CCSSO, 2010
Math should make sense
- make sense of problems and persevere in solving them
- communicate precisely to others
- use clear definitions in discussion and in reasoning
- state the meaning of symbols used, specifying units of measure, and labeling axes
- note the assumptions made
NCTM: Reasoning and Sense Making in High School

- Algebra
- Data Analysis
- Geometry
Polya’s Ten Commandments

Read faces of students

Give students “know how”, attitudes of mind, habit of methodical work

Let students guess before you tell them

Suggest it; do not force it down their throats (Polya, 1965, p. 116)
Polya’s Ten Commandments

Be interested in the subject
Know the subject
Know about ways of learning
Let students learn guessing
Let students learn proving
Look at features of problems that suggest solution methods  

(Polya, 1965,p. 116)
References

- Common Core Standards. *College and Career Standards for Mathematics* 2010). Council of Chief State School Officers (CCSSO) and (National Governor’s Association (NGA).

