

# What Algebra is Left to Learn in the CAS Classroom?

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**Now that Calculators Can  
Do Algebra, What's Left to  
Learn in Algebra Class?**

# Why this Topic?

- [Linear Equation.tns](#)

# It's not just CAS.

- [JustCounties.ftm](#)

# Technology Use in Classrooms

- Ban it!
- Use it whenever students want.
- Manage its use.



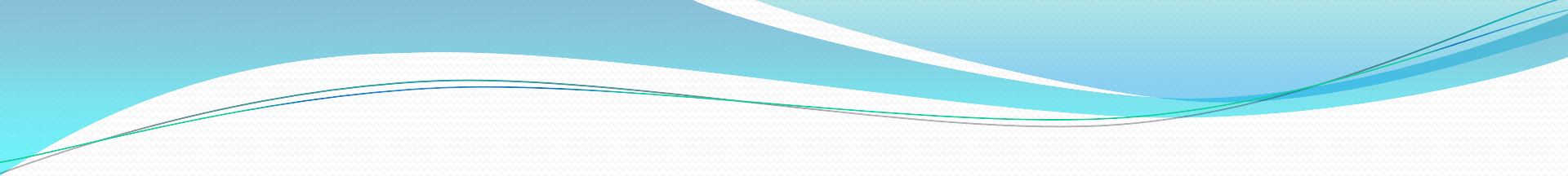
**Socrates** (c. 425 B.C.) in *Phaedrus* worried about the invention of the alphabet and writing :

If men learn writing it will implant forgetfulness in their souls; they will cease to exercise memory because they will rely on that which is written, calling things to remembrance no longer from within themselves, but from external marks.

(With thanks to Zalman Usiskin for pointing out this passage.)

# Technolgy is...

- A **Crutch** to help us do things we could do without help
- A **Tool** to help us do things we could not do otherwise



We need a clearer framework  
for thinking about the role of  
technology.

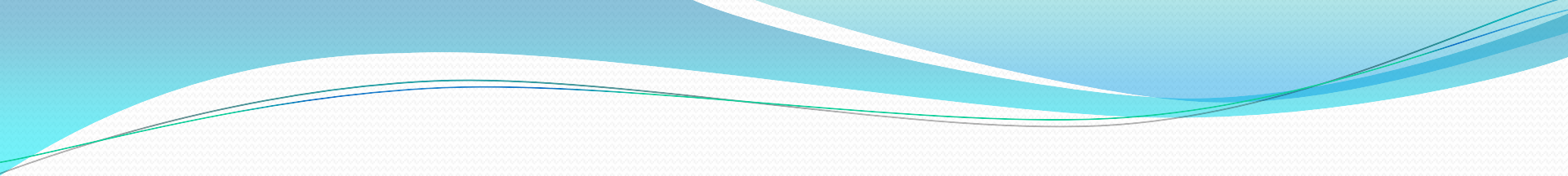




# Some Organizing Questions about the use of Technology

# Automaticity

- What do we really need to know by heart?
- What skills need to be automatic for understanding?
- What level of automatic skill do we need in order to use technology well?



What do we need to  
do **by heart** and **by**  
**hand**?

# Fluency with Algebra

- What does it mean to be fluent with Algebra?
- What level of fluency is needed to take best advantage of technology?



# Patricia Davidson's Brain Research

## *What the Machine Can't Do*

- Understand Problems.
- Model Problems.
- Make Useful Representations.
- Interpret Solutions.



# Reading



# Reading Graphs and Functions

[rational function.tns](#)





The technology can't do the  
conceptual heavy lifting.

# Learning the technology well

- We assume that kids know how to use high-end features of calculators.
- Tech skills need to be stretched.
- Need to find worthy problems

## Some Changes?

- Emphasis will shift from Equation Solving to Equation Writing?
- More Work on Mathematical Modeling?

$$.11x+30.=.19x+15.$$

- Plan A Phone Service: \$0.11 per minute plus \$30 monthly charge
- Plan B Phone Service: \$.19 per minute plus \$15 monthly charge
- from *Principles and Standards*



# Calculator Guilt



Some related issues....

Which form is  
more useful?

$$\sqrt{50} \quad \text{or} \quad 5\sqrt{2}$$

# Rationalizing Radicals

$$\frac{1}{\sqrt{2}}$$



What about these?

$$8^{\frac{1}{3}}$$

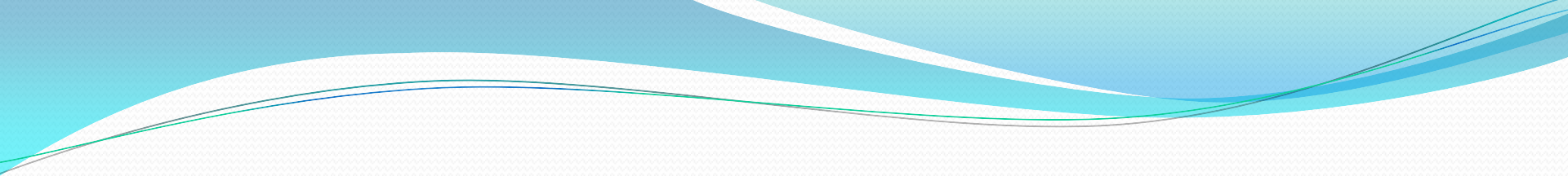
$$\sqrt[5]{32}$$

# The importance of Estimation

- Benchmarks—Numerical and Symbolic

$$\sqrt{80}$$

$$\lim_{x \rightarrow \infty} \sqrt{x^2 + 10}$$


$$\sqrt{a^2 + b^2} \neq a + b$$

$$x^2 - y^2$$

$$= (x + y)(x - y)$$

# What it means to simplify mathematical expressions

- Make it *easy* to read.
- Make it *easy* to correct.

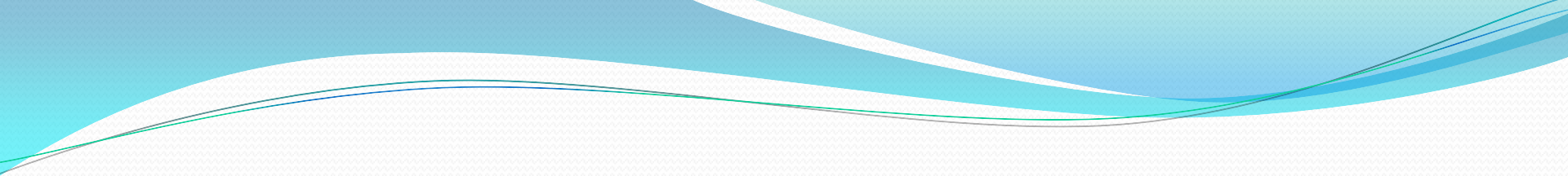
# Which form is Simpler?

$$\frac{1}{z} + \frac{y}{x} + \frac{1}{\sqrt{2}}$$

or

$$\frac{2x + 2yz + xz\sqrt{2}}{2xz}$$

Thanks to Henry Pollak for this example.



Does Technology Undermine or  
Trivialize the Curriculum?

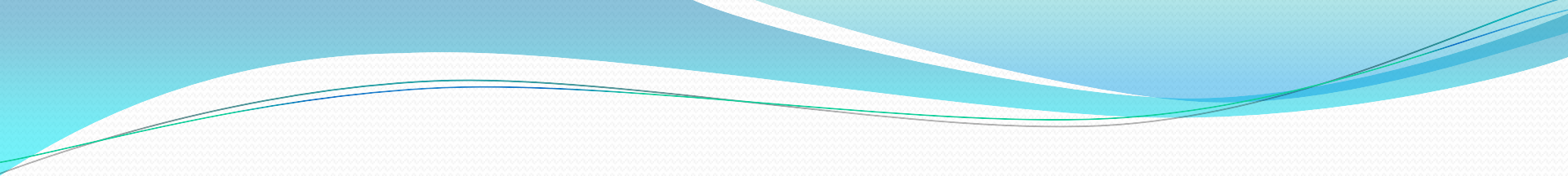
# Are We Teaching Obsolete Skills?

- There are obsolete skills that we **like** to teach.
- There are obsolete skills that are so entrenched that they are part of the “culture” of high school mathematics.
- There are obsolete skills that make good testing topics.





Technology is not a  
threat; it's a challenge.



Technology is growing  
faster than our  
wisdom about using  
it.



Thank you!

# Resources

- *Fathom 2*, Key Curriculum
- TI-*n*Spire CAS Computer Software