Communicating Mathematical Meaning

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Introduction

- **The world is becoming more math-oriented,**

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- **The world is becoming more math-oriented, and there are opportunities for people who understand math:**

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Imagine future research directions:

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- Transportation:

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Math and Ethics

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What the employers have said

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They recommend that students should

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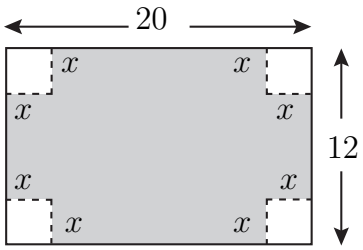
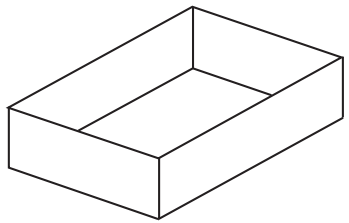
- learn about another discipline

Student error 1

A box with an open top is to be constructed from a rectangular piece of cardboard with dimensions 12 in. by 20 in. by cutting out equal squares of side x at each corner and then folding up the sides as in the figure. Express the volume V of the box as a function of x and give the domain of $V(x)$.





(a) $V(x) = 12 \cdot 20 \cdot x$ with domain $= (-\infty, \infty)$
(b) $V(x) = 12 \cdot 20 \cdot x^2$ with domain $= (-\infty, \infty)$
(c) $V(x) = x(20 - x)(12 - x)$ with domain $= (-\infty, \infty)$
(d) $V(x) = x(20 - x)(12 - x)$ with domain $= (0, 12)$
(e) $V(x) = x(20 - x)(12 - x)$ with domain $= (0, 20)$
(f) $V(x) = x(20 - 2x)(12 - 2x)$ with domain $= (-\infty, \infty)$
(g) $V(x) = x(20 - 2x)(12 - 2x)$ with domain $= (0, 6)$
(h) $V(x) = x(20 - 2x)(12 - 2x)$ with domain $= (0, 12)$

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A cricket produces 142 chirps per minute at $50°F$ and 152 chirps per minute at $100°F$. Find a linear equation that models the temperature T as a function of the number of chirps per minute N.

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- This communicates the message that an answer is wrong if you leave a square root in the denominator.

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(2) Terminology: Improper fractions (without further explanation)

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$$\frac{8}{3} \text{ is an improper fraction. So } 2\frac{2}{3} \text{ must be better?}$$

- The message students get is an improper fraction is not good.
- However, in the real world it is much easier to use improper fractions when working on problems.

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"all of them!"

The teacher had been expecting the students to think "2, 4, 6, 8."

What are other examples in which the way a concept is taught can lead to students' misunderstanding?

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Group Discussion: What do you think?

Why do some students succeed and some fail university mathematics?

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Small Group Discussion: What do you think?

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Small Group Discussion: What do you think?

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Some ideas:

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- Most students have a stronger procedural knowledge of mathematics
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- Most students feel comfortable using their strengths, but not their weaknesses in university mathematics courses. This hinders their deeper learning of mathematics.

Why do some students succeed and some fail university mathematics?

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Some ideas:

- Most students have a stronger procedural knowledge of mathematics
- Most students have a weaker conceptual understanding
- Most students feel comfortable using their strengths, but not their weaknesses in university mathematics courses. This hinders their deeper learning of mathematics.
- Mathematically stronger students also begin with their strengths but then venture into less comfortable areas while studying.

Students' understanding of limits

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Examples:

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Group Discussion: How do these nonmath meanings of "limit" affect students?

What are the ways that mathematical “limit” is presented in a classroom?

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  - multiplying by the conjugate
  - L'Hospital's Rule

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Group Discussion: Are these descriptions connected or are they taught as separate items?

Researchers have shown that although students can "do" limit problems, they do not grasp the definition and when asked to explain what a limit is, they rely on explaining the procedures used to calculate the value.

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Students may develop misconceptions of the limit:

- limit as a bound,
- limit as an approximation of the function value, and
- limit value as equal to the function value.

Teaching to better communicate mathematical meaning

Group Discussion: What are different ways to teach a math concept?

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2. Integrate various representations in the curriculum emphasizing the strengths and weakness of each in the context of the problem being solved.
3. Help students develop their own examples to make sense of concepts.
4. Discuss similarities and difference among concepts such as limit, continuity and differentiability.

Thank you!

Thank you!

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