MY FAVORITE lesson

Kevin D. Winiarz

# Complicate *This*!

"What exactly are we supposed to do when the directions say, 'Simplify'?"

One subtle yet nearly ubiquitous difficulty for mathematics students involves understanding directions. My response to this second-year algebra student's question was that *simplify* means to put the term or expression in its most basic form by performing all operations and reductions. Although satisfactory for this student's specific query, the answer to this question is neither easy nor absolute; it depends on context and aesthetic preference. Browse some mathematics dictionaries and carry out an Internet search to see for yourself.

Students' difficulty in correctly comprehending the meaning of terse, somewhat cryptic instructions is not uncommon and may explain why some students mistakenly attempt to solve for a variable in an expression when they intend to simplify. Directions to simplify an expression such as $4 \cdot (9 - 3) + 2$ seldom lead to confusion or errors, but trouble occurs when the expression contains a variable, such as $3x - 4 + 2(8x - 4x)$. In this case, some students try, mistakenly, to solve for $x$.

To help students understand the distinction between solving and simplifying, I use the following tactic. On the board, I write something like this:

Simplify: $10 + 3 - 5(6/2)$.

I explain what I mean by *simplify*, and the class and I complete the example together.

Next I write this:

Complicate: 5.

I explain that I want students to reverse the simplifying process with the quantity 5. That is, they are to *unsimplify*, to go backward using a chain of arithmetic reasoning and procedures to create a more elaborate, complex way to represent 5.

Initially, many students create straightforward examples, such as $2 + 3$ or $10 - 5$. I suggest that they use the identity elements of addition and multiplication as well as square roots, thus generating representations such as $\sqrt{36} - 1$. If they have not yet done so, I then encourage students to create expressions that contain one or more variables and also terms of degree greater than one, thereby incorporating algebraic representations and using properties of exponents in their creative efforts. This prompting produces representations for 5 such as

$$\frac{30x}{6x} \text{ and } \frac{\left(\sqrt{5}\pi y\right)^2}{\left(\pi y\right)^2}.$$

To conclude our complicating tasks, I ask each student to choose any whole number and complicate it, requiring at least one variable in the process. Students work for a few minutes, and then I distribute index cards on which they write the complicated expression for their chosen number. They exchange cards with classmates, and I ask each one to simplify the classmate's expression. After simplifying for a few minutes on their own, students pair up with the person with whom they exchanged cards and check the accuracy of their complicating and simplifying procedures. Once students have successfully completed this activity, we can extend the idea to a polynomial with one or more variables—for example, "Complicate: $3x + 5$."

This exercise is analogous to disassembling and assembling an object such as a bicycle or a bookshelf using a given set of instructions. If a person can take an object apart and put it back together, or vice versa, he or she likely has a reasonable understanding of the processes at work. The simplify-complicate exercise allows students to accept more readily an agreed-on meaning for the phrase *simplify*. A bidirectional context emphasizes the fundamental properties and mechanics of arithmetic and algebra.

Have your students complicate some mathematics!

**KEVIN D. WINIARZ,** kevin_d_winiarz@mcpsmd.org, teaches mathematics at Sherwood High School in Sandy Spring, Maryland.

The Back Page provides a forum for readers to share a favorite lesson. Lessons to be considered for publication should be submitted to mt.msubmit.net. Lessons should not exceed 600 words and are subject to abridgment.

*Edited by **Roger Day,** day@ilstu.edu, Illinois State University, Normal, IL*

**CORRECTION**

"Modeling Exponential Decay" (The Back Page, *MT* December 2013/January 2014, vol. 107, no. 5, p. 400) shows significant similarity to work by Henri Picciotto. Consequently, Mr. Picciotto's work should have been added to the reference list: http://www.mathedpage.org/calculator/index.html#rolling.

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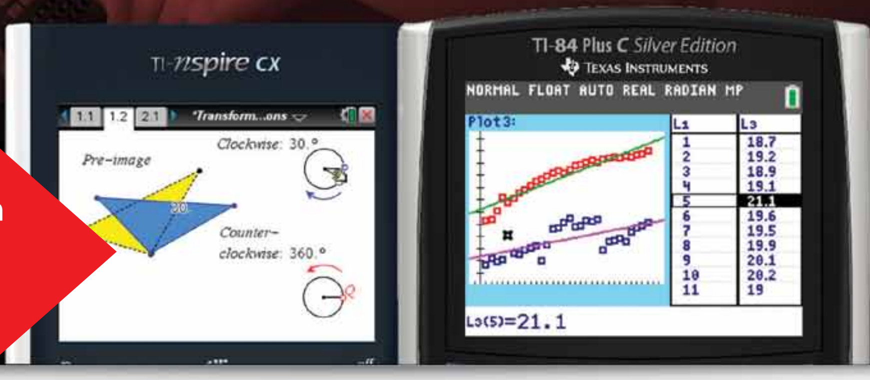


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