Don’t Just Do The Math–Type It!

Greg Stephens

Most word processors, including Google Docs™ and Microsoft® Word, include an equation editor. These are great tools for the occasional homework problem or project assignment—and not just because teachers can finally read students’ homework! Getting the mathematics to display correctly means making decisions about exactly which elements of an expression go where. Even better, the feedback is immediate: Students can see an expression go where. Even better, the editor. These are great tools for the classroom and guidelines for submitting assignments—and not just because I regularly assign a problem as a “typed” exercise. Here is a sample prompt to accompany a list of expressions or a set of textbook problems: Choose a rational expression to type into an equation editor. Start with the original expression and include each step in the process of simplifying the expression. Annotate each step with a sentence or two explaining what you are doing. Consider how the prompt might play out for different students who are asked to simplify expression 1. A reasonable first step would be to start factoring the numerator and the denominator, yielding expression 4.

\[
\frac{x^4 - 16}{x^2 - 8x + 16} \rightarrow \frac{(x^2 + 4)(x + 2)(x - 2)}{(x - 4)^2}.
\]

A student might write something such as “I recognized that \(x^2 - 16\) was the difference of squares and that \(x^2 - 8x + 16\) was the square of \((x - 4)\).” Another student might explain, “I factored everything so that I could cancel things out.” The two responses highlight different aspects of each student’s plan. We might ask the first student, “Why? What

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Which Equation Editor?
The menus in Microsoft Word and Google Docs are very different, but the ideas are the same. Each editor offers a template of mathematical structures to complete with the appropriate letters and numbers. Use the insert menu in either program to get to the equation editor. In Google Docs, one option is to insert an equation. In Microsoft Word, the equation editor is an option on the right of the first ribbon. The key difference is in the appearance of the template. Figures A and B show the different looks of the two programs.

Fig. A MS Word equation editor highlights the input box with a dotted border.

Fig. B Google Docs equation editor uses a blinking cursor to highlight the opportunity to type.
Nurturing Persistent Problem Solvers

Problem solving lies at the center of what it means to do mathematics, and few meaningful problems can be solved without persistence. This is part of the message of both NCTM’s Principles to Actions and the Common Core’s Standards for Mathematical Practice. The Editorial Panel of Mathematics Teacher invites teachers, teacher educators, education researchers, and others to share their experiences and ideas about how to nurture persistent problem solvers.

The following questions may serve as starting points for thinking about this subject:

Problem Solving
• How do you balance individual perseverance and group collaboration?
• How do you help your students develop a problem-solving process?
• What technological tools do you use or provide to assist students in solving problems?
• How do you assess your students’ problem-solving skills?
• What research helps mathematics teachers nurture persistent problem solvers?

These are just a few of our ideas; we want to know what you think. In addition to feature-length submissions (2000–3000 words), we are also interested in one-page submissions (600–700 words).

Submit manuscripts at mt.msubmit.net by May 1, 2016. Be sure to enter the call’s title (Nurturing Persistent Problem Solvers) in the Calls field. No author identification should appear in the text of the manuscript. Manuscript guidelines are available at nctm.org/mcalls. If you have ideas related to this topic and wish to discuss them before sending a manuscript, contact Tara Slesar (tlesar@nctm.org).

CALL FOR MANUSCRIPTS

Fig. 3 Symbolic interpretation and mathematical connection are highlighted in one student’s slide.

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I get a notebook page of student work. I tell students that the move from draft form to typed form is like turning professional; it requires enormous attention to detail and final product.

MASTERING THE TEMPLATES

Students will almost certainly complain that the effort to make everything display correctly is time-consuming (and they are right!). Remind them to use the cut-and-paste functionality to easily show successive steps; they should make a copy and edit rather than starting from scratch each time. Luckily, cutting and pasting in the equation editor is essentially the same as in any other computer application, so there is no learning curve at all.

An advantage of using an equation editor is that the students can self-correct and help one another—a much better approach than having teachers correct students’ mistakes. Students seem to remember the ideas much better when they make their own connections between the order of operations and the templates.

The more that we ask students to confront the very nature of mathematics, even when it is simple, the more they internalize the meaning of the things we try to teach. The simple act of asking for typed work can have deep implications for mathematical thinking—and the results are easy to read as well!

PROFESSIONAL-LOOKING PRESENTATIONS IN A CALCULUS CLASS

In my Calculus class, I ask students to research and analyze selected velocity data. The goal is to predict how many feet a car travels to reach 100 mph. Students summarize their work and results in an organized and typed presentation that must stand alone (i.e., the slide show, report, or poster is sufficient unto itself; nothing has to be explained by the student).

In her final report, one student turned in the wonderful slide shown in figure 3. The formatting of the slide shows how well the student understands the mathematics and how comfortably she uses Google’s equation editor. The limits of integration as “start” and “stop” values and the integrand as a regression equation created from the test data, are highlighted with arrows and text boxes. Her final sentence specifies a mathematical connection: The integral represents the area under the curve. (Although units do not appear anywhere on this slide, she connects them with reference to distance and velocity on the next slide in her presentation.)

The combination of symbolic mathematics and written narrative—in some form of “public” presentation—gives me a much greater sense of what connections a student has made than when

was your rationale for this step?” The second sentence captures the strategy, but we might probe, “Do you realize that the expression has not been factored completely?” The process, preserving equivalence, is an appropriate strategy completely?” The process, preserving equivalence, is an appropriate strategy.

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A student moving from expression 4 to expression 5 likely has concluded that eliminating the two $(x + 2)$ factors would keep expressions 4 and 5 equivalent. As a bonus, the organization of expression 5 helps illustrate that $(x^2 - 4)$ is not all the same thing as $(x - 4)^2$, even though the two expressions have exactly the same symbols.

Seeing typed student work can offer teachers clarity about how students sequence their steps. In handwritten work, steps are often layered on top of one another (as students cross out and show successive steps; they should make a copy and edit rather than starting from scratch each time. Luckily, cutting and pasting in the equation editor is essentially the same as in any other computer application, so there is no learning curve at all.

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Keep the assignments short and clear.

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