

Teachers' Technology Class Continues Discussion of Pitfalls

You may recall the “April Fool’s” Technology Tips column published during the 2004–2005 school year in which Todd Lee and his colleagues described some pranks that technology regularly plays on its users. In this month’s tip, Larry Lesser and his students respond to these tips and add more possible technology pitfalls to the list. Lesser’s examples use TI graphing calculators, Microsoft Excel, Mathematica, and InFocus projection devices. The “Surfing Note” this month includes a link to a large collection of interactive Java-based course materials for exploration in mathematics and science.—Eds.

The April 2005 “Technology Tips” facilitated rich discussion and written reflection for the Technology in the Math Classroom class that is required at the University of Texas at El Paso for the degree of master of arts in teaching with a major in mathematics. Our course included the use of the Internet, LOGO, Excel, TI-83/84 (including many APPS and CBR/CBL), Minitab, Mathematica, and The Geometer’s Sketchpad. The students used Glazer (2001) as a text and in the future will draw from the 2005 NCTM Yearbook as well. Students from this class who are cited in this article are all teachers at El Paso County high schools and are hereafter referred to as teachers.

While surprised (but grateful) to learn about pitfalls in commonly used technology in high school mathematics classes, each teacher in the class remained strongly committed to its use in the classroom. They appreciate how technology can motivate and reach diverse students, and they know that the use of technology often leads to reconnecting with or delving deeper into underlying mathematics

(e.g., “Making the Black Box Transparent,” *Mathematics Teacher* 92 [December 1999]: 780–84). The reflections reminded the teachers and the author of many pitfalls not mentioned in the article or that might not be obvious to the user.

TI GRAPHING CALCULATORS

First, we share additional TI-83/84 pitfalls that were generated by the teachers. Users may not realize (or recall) that the syntax $\text{LinReg}(ax+b)$ L1, L2 assumes L1 is the independent and L2 the dependent variable. A different regression equation is obtained if they are swapped. This is easy to trip on, since a swap will not change the sign of the slope or the correlation coefficient. In a better world, LinReg would prompt the user separately for an Xlist and a Ylist, just as the calculator does in STATPLOT. Perhaps the next model’s LinReg could also prompt the user for the correlation coefficient rather than making the user remember to activate DiagnosticOn.

The expression $(5^{14})/4$ was provided in the April 2005 “Technology Tips” as an example of how a lack of critical thinking could lead to misinterpretation of the calculator output. Some pitfalls were not mentioned, however, which are far more likely to be encountered by a high school student:

- (1) a precalculus student calculating (in radian mode) the expression $\sin(4\pi)$ and believing the calculator’s nonzero output of $-2E-13$ (**fig. 1**)
- (2) a calculus student trying to find the derivative at the corner of an absolute value function and getting a defined answer (**fig. 2**)
- (3) a student entering the built-in “e” (above the division sign key) and con-

This department offers a forum where teachers can share innovative classroom activities and ideas related to teaching and learning mathematics using technology. Ideas using all types of classroom technology are welcome. Send tips to the “Technology Tips” editors.

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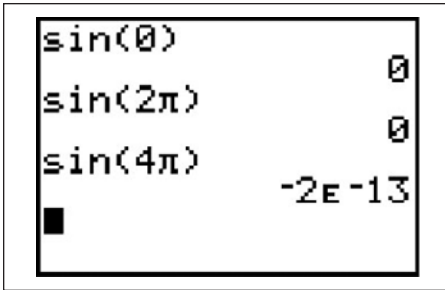


Fig. 1 The output of $\sin(4\pi)$ in radian mode

cluding from the displayed ten digits (2.718281828) that e is a rational number (271801/99990)

Would a student “disprove” the latter result by subtracting 271801/99990 from e and obtaining a nonzero answer? For that matter, would a student wonder if the decimal for, say, $1/17$ really repeats? The numbers represented by $6.5E7$ and $6.5 \times 10E7$ differ by only one additional appended zero. This difference might not be noticed by a student who fails to remember the convention for using the EE scientific notation operator (shift “comma,” which is above the “7”) to enter the number 6.5×10^7 .

Also with the TI-83/84, Liz Rayas noted that “using the TRACE function, you can’t get exact x -intercept values to convince skeptical students,” but students need to know they can use the zero or intersect commands from the 2nd CALC menu or the solve command from the 2nd CATALOG instead. Also, a line’s slope and circle’s eccentricity appear distorted in the default (or “ZStandard” ZOOM) setting but can be corrected with the “ZSquare” ZOOM setting. On the TI-83/84, students sometimes have a hard time reading the graphical display of discontinuous functions such as $(x^2 - 4)/(x - 2)$ or $\tan(x)$. In the standard window, will a student say $y = \text{int}(x)$ looks like a “step function” (fig. 3)? What about $y = 1 - (x/12)$ (fig. 3)?

Gabriel Trujillo’s comments centered on order of operations, which can usually be addressed by simply adding parentheses to clarify intentions, such as $(16/8)/(4/2)$ versus $16/8/4/2$. Schools with class sets of older model calculators should be aware of certain discrepancies. For example, Aracely Vargas noted that if a student types $y = 1/2x$ into a TI-82, the graph will look like a (discon-

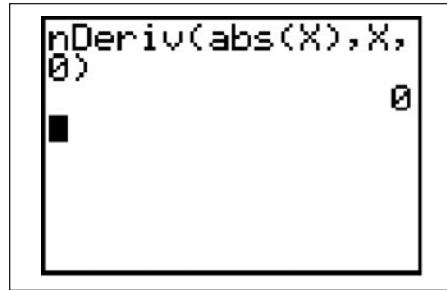


Fig. 2 The output of the nDeriv at the corner of the absolute value function

tinuous) rational function, while on a TI-84, it appears as the line the student probably intended.

MICROSOFT EXCEL

As for the Microsoft Excel histogram difficulties mentioned in the April 2005 “Technology Tips,” an alternate solution is suggested by Middleton (2004), who offers an add-in that can be downloaded from www.treeplan.com/better.htm at no charge. A Web-based solution that allows for dynamic explorations between the data and the chart can be found as an applet on www.shodor.org/interactivate/activities/histogram/index.html. Also, a real-world example of how the fundamental appearance of a histogram can vary dramatically with bin size is located at www.amstat.org/publications/jse/v6n3/applets/Histogram.html.

OTHER TECHNOLOGY

Teachers in the Technology in the Math Classroom class included in its discussion forms of technology not mentioned in the article, such as Mathematica. Mathematica is a powerful CAS package with very particular syntax requirements (e.g., use of brackets or capitalization). For example, a problem from one of our class assignments asked students to implement and discuss the result of this command:

```
ParametricPlot[{Sin[t],
Cos[t]}, {t, 0, 2Pi}]
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One student inadvertently left a space between the words *Parametric* and *Plot*, which caused Mathematica to implement the (regular) Plot command. The output, therefore, was one period of the sine and cosine graphs instead of the intended graph of a unit circle (fig. 4).

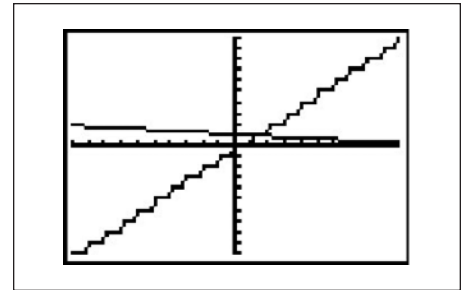


Fig. 3 The graphs of $y = \text{int}(x)$ and $y = 1 - x/12$ in ZOOM 4

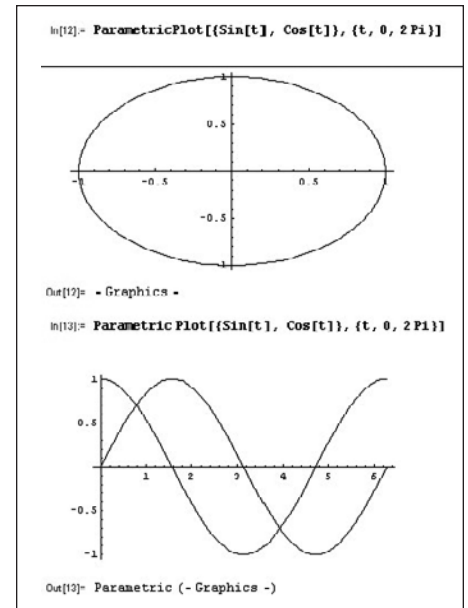


Fig. 4 Sample outputs of “ParametricPlot” and “Parametric Plot” using Mathematica

Other reflections addressed presentation technology. For example, Yogesh Velankar cautioned that the InFocus projector “needs to be plugged into the computer before the computer is turned on, and then after that it needs to be powered on.” On a related note, it is easy to think the cord is pushed in all the way to connect a graphing calculator and CBL when it is not. And how many of us have tried to “wake up” a recently active (but sleeping) screen by pressing ENTER (instead of ON) and unintentionally put ourselves on a different screen?

CONCLUDING THOUGHTS

A typical textbook for a secondary mathematics methods course includes a chapter on technology but rarely touches on these pitfalls (perhaps, in part, for space reasons). Our experience has shown, however, that secondary teachers are quite interested in learning about as

many of the most commonly encountered pitfalls as possible (especially in our safer environment) and have the maturity and perspective not to turn against technological tools over a few limitations and quirks any more than they would abandon a wonderfully progressive textbook with a few typographical errors.

It was also interesting to experience how basic tools can often be used in complementary ways to resolve pitfalls, such as using the Internet to find creative applications, applets, macros, and help manuals to enhance or support the other technologies.

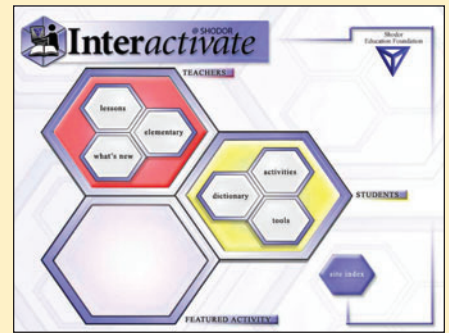
—Larry Lesser with Liz Rayas, Gabriel Trujillo, Aracely Vargas, and Yogesh Velankar, *University of Texas at El Paso, El Paso, TX 79968*

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Surfing Note

<http://www.shodor.org/interactivate/>

Project Interactivate is a Web site created by the Shodor Foundation, “a non-profit research and education organization dedicated to the advancement of science and math education, specifically through the use of modeling and simulation technologies.” Although this online collection of lesson plans and Java applications was designed to correspond to the NCTM middle school content standards, many of the applications also address topics in the high school curriculum. Moreover, “both subject matter and presentation are designed to address a wide range of learning styles, embrace diversity, and generate true interest in mathematics rather than a fleeting familiarity with a few computational algorithms.” Some of the mathematical topics on the Web site include: fractal and transformational geometry, linear and quadratic functions, probability, and statistics.



not their contributions were included.

REFERENCES

Glazer, Evan. *Using Internet Primary Sources to Teach Critical Thinking Skills in Mathematics*. Westport, CT:

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Middleton, Michael R. “Better Histograms Using Excel.” *Proceedings of Decision Sciences Institute*, 2004. ∞