# Four Practices That Math Classrooms Could Do Without

While the big debates about mathematics instruction focus on the question of reform versus back to basics, Mr. Fiori would like us to consider a different question. Why does school mathematics bear so little resemblance to the way practicing mathematicians think?

**BY NICK FIORI**

THE MATH classroom is, and probably always will be, a center of controversy. Teachers, mathematicians, and researchers may never come to agreement on exactly how their beloved subject is to be represented in school. That said, aren't we all making some obvious mistakes? I contend that there are some practices, common to nearly all math classrooms, that we can all agree simply *must* be done away with. Here are my four prime candidates.

1. *Forty problems a night.* Most of my mathematician friends and I are only able to solve about two problems a year — if we're lucky! Tell a mathematician you've solved even five problems in a single day, and the first thing she will think is, "They must not have been very interesting problems." Outside of mathematics, does anyone you know ever get 40 things done in a day? Even the mundane problems of our life don't get packaged away that quickly. My daily "to do" lists rarely contain more than eight items, and by the end of the day I'm fortunate if I'm through half of them. Let's cool it with the daily deluge of exercises and reconsider the quality of the problems that can be completed at a rate of 40 per night.

2. *The third-person czars of math problems.* A strange, anonymous set of people are constantly referred to in math classrooms. We frequently hear teachers and students ask

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*Illustration: Jem Sullivan*

such questions as "What do you think *they* mean in problem number 4?" or "What do *they* want us to write as an answer?" The responses follow suit: "I think what *they're* looking for is an expression for $x$ in terms of $k$."

Who are these people? *They* don't seem to be the teacher, and *they* certainly aren't the students. Are *they* the authors of the textbook? Or are *they* the faceless people who invented or discovered mathematics in the first place? How do we know that there are more than one of them? All of these questions leave me in a panic. It can't be healthy for a subject to be controlled by a bunch of nameless cronies. Aside from a few pictures, the sidebars, and an occasional name attached to a theorem, there are no *actual people* in math books. This is true of elementary workbooks, high school texts, and even most college mathematics books. If we decide, as we often do, that our classrooms are going to be guided by the mathematics of the past, then let's at least talk about real people — not mythical ones.

3. *Teachers give problems; students give answers.* If only mathematics were that easy! A mathematician would arrive at her desk to find that her problems were all there, waiting for her in a list. The reality is that the largest challenge in mathematics is *finding* a good problem to solve or theorem to prove — a single conjecture that is both interesting and approachable. In a bout of frustration that is relived daily by graduate students and researchers, Bernhard Riemann once longed wistfully to skip the difficult, but more interesting, part of mathematics: "If only I had the theorems! Then I should find the proofs easily enough." As it is, mathematicians don't get to skip the problem-finding part, and the subject is the richer because of it. In spite of this fact, you would be hard pressed to find a classroom where the students regularly face the challenge of finding a good problem.

4. *Harbor a mistake, and you are a scoundrel.* Gasp! Suppose a student still "doesn't get it" by the end of a math class, and the teacher decides not to set him straight for the time being. Many people would label such a decision as "immoral," fearing that it would endanger the student's academic future. Because of the high stakes we attach to learning math in school, we seem to lose our perspective on these matters. Do we really think that mathematical learning is that simple and straightforward? Might a student have a richer mathematical experience if he is allowed to fumble around with a misconception for a few days than if he is steered promptly to the "truth"?

We must deemphasize answers and correctness as the only worthy goals in mathematics. Sure, "right answers" are an important part of math, but they aren't always the bottom line. Instead of always asking, "What's the right answer?" we should also wonder, "What's the right *question*?" and "What's the most interesting *way* to the answer?" Mathematics is about bold, adventuresome ideas, and the history of the subject is therefore fraught with mistakes, confusion, and invalid convictions. Let's make the classroom a bit more like the discipline and allow our students to revel in the "wrong" while they pursue the "right." **K**

# Why? Why? Why?

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bring it to the next level. . . . I now feel a lot more confident in my knowledge of math because I have the background knowledge and the proofs of everything I've learned. I know the *why* and not just the *how* of the math I do."

Our future teachers are very motivated to do anything that will benefit their future students. We can help them become comfortable asking questions that explore the depth of mathematics and make its beauty visible. Then they will be more likely to spend the time required to understand the concepts, and, once they understand the concepts, the procedures will fall into place. When teachers develop their inquiry abilities, they become more motivated to persevere when stuck on a problem, for they can ask the questions needed to break the problem down into bite-size pieces or to approach the problem in a different way. They may be surprised at how much they actually understand if they continue to try and fight the instinct to give up, even after experiencing frustration. Then our teachers will be better able to help their own students acquire these same skills and dispositions.

Let the music of mathematics resonate within us! Let us seek its depth, its beauty. Let our future teachers recall their own wonder and curiosity and their tenacity in searching for answers. Then they and their future students will ask not just "How?" in mathematics but "Why? Why? Why?"

1. G. H. Hardy, *A Mathematician's Apology* (Cambridge: Cambridge University Press, 1940).
2. Liping Ma gives some nice examples of depth in elementary mathematics in *Knowing and Teaching Elementary Mathematics* (Mahwah, N.J.: Erlbaum, 1999).
3. Deborah Ball and her colleagues have published many articles about specialized mathematical knowledge for teaching.
4. There are some laser-guided measuring tools used by craftsmen that can calculate the area of a region by measuring its perimeters. However, such tools take into consideration the shape of the region.
5. Actually, this question is not a mathematical one. It was a choice made by the Babylonians and is related to the fact that the period of rotation of the Earth around the Sun is 365 days. Some "mathematical facts" are historical accidents, arbitrary choices made in the past, while others are necessary and logical consequences of definitions and axioms. It is crucial for teachers to understand this distinction and to help children do so as well.
6. "Math Will Rock Your World," *Business Week*, 23 January 2006, pp. 54-62.
7. Richard Feynman, *The Character of Physical Law* (Cambridge, Mass.: MIT Press, 1965.) **K**