
Letters to the Editor

Computers in Mathematics Education

I don't understand why the editors published the first letter in the July 1996 *Notices*. The writer began with an attack on rhetoric instead of substance, admitted to ignorance of the courseware, took refuge behind a phony abstraction, demonstrated gross ignorance of software development, and denigrated engineers and "Computer Scientists (programmers)". Worse, the writer presented a ludicrous "proof" that it was a "trivial matter" to add a feature to courseware that would answer all the user's questions. The closing completely misrepresented another writer's words: somehow a call for more participation by research mathematicians was transmogrified into a call for a bizarre, radical experiment. The decision to publish such careless and uninformed tripe was a galling lapse in judgment.

Galperin's hallucination about "compumatics" bears no resemblance to the computer labs or Calculus & Mathematica classrooms I've observed. A brief visit to our computer lab would quash his fear of losing jobs—it is nothing like instructorless programmed instruction. A real problem is that many "technology" supplements tacked onto traditional textbooks are pedestrian filler. His attempted sarcasm, "shining path of computer-generated science for the everlasting progress of mankind" (Amen), fails because so much theoretical scientific work requires using a computer. Most experimental data is collected and analyzed using a computer. Most industrial design and de-

velopment uses a computer. We cannot ignore the computer. Regardless of how the reform movement changes the course we call calculus, computers are going to roll over the current set of courses and squash them flat. We had better be ready. It isn't a nefarious business conspiracy "addicting students" to software, but the real world of science knocking at the door.

Calculus is a "service" course. Calculus is a major source of revenue for math departments. We forget either fact at our peril.

With the advent of tools that automate long and messy calculations, we are no longer limited to *The Calculus One Can Do by Hand* on an hour exam. Only a fool would turn calculus into button pushing, but students no longer need to overlearn skills (in the cognitive sense of "automate") that a computer can do faster and more accurately. We can now stretch the limits of the course to include large symbolic and numerical computations. Conceptual understanding becomes even more important, both to guide the calculations and to make sense of the results. We can now include serious applications and not the plug-'n-chug pretenders littered through many calculus textbooks. The greater scope of real problems intensifies the need for students to seek understanding—and provides a context to aid and inspire learning.

Galperin's attempt to define a lesser class of "compumaticians" is the sort of intellectual snobbery that will erode enrollments in our service courses. When a sophomore described to me how he used his knowledge of

splines and software during the previous summer, it illustrated why our service courses must move with the modern world. We must include the powerful tools that are available to everyone doing serious mathematical work. The alternative is to watch our departments wither into irrelevance. Unlike Galperin, I don't intend to go gentle (and pious) into that good night.

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(Received July 16, 1996)

Tolerance for Different Teaching Methods

The letter in the July *Notices* from Daniel Flath et al., in response to Jerry Rosen's letter concludes with, "We would welcome even more their active participation and constructive criticism." The implication presumably is that he is not participating actively in educational matters. Without knowing more about him, that would be an unwarranted assumption. Anyone who teaches is participating actively in the most meaningful way in education.

I think what many people mean by "active participation" is government-funded programs that give detailed instructions on how everyone should teach a particular subject (calculus is under particular pressure right now). And here I think many "practicing mainstream mathematicians" are indulging in the same fallacy that many modern American colleges of education do: the idea that teaching is a hard science, that there is an absolute

right way and wrong way to teach. I disagree completely. If another teacher wants to form students into groups for discussion, I will not interfere. If the teacher has sufficient mathematical credentials, I trust her/him to make any decision regarding how she/he teaches. But I would resent that teacher trying to insist that I teach the same way.

What I would like to see in teaching matters is more tolerance of individual styles of presentation. Teaching techniques that work for me may not work for other teachers. Everyone has a style of teaching that they do best with. Adaptations to each class are also desirable. The idea of a single, micromanaged teaching technique for all students and all teachers, dictated from a centralized bureaucracy, is degrading to the human spirit of both the teacher and the students. It reduces both teachers and students to automatons, interchangeable units in a vast machine. Both students and teachers are diverse in their intellectual outlook and make-up; students benefit from having a variety of teaching techniques to choose from.

I am making a distinction here between what is taught and how it is taught. So long as the teacher is mathematically qualified, she/he should be trusted to make decisions about how the subject is taught: in what order concepts are presented, whether to use computers, etc. There does need to be some minimal standardization of what is taught, at least when it comes to handing out degrees. A given degree at one university should bear some superficial resemblance to the same degree at another university. The best way to ensure that would be to have proficiency exams, as we now do for many high school diplomas. But how one arrives at the knowledge required for passing such an exam should be the business of the individual teachers and students.

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(Received June 21, 1996)