College Dean Dennis DeTurck Is Taking on the Math Establishment — and Penn's General Requirement

DOWN with Fractions

There's an old math joke: Two-thirds of Americans can't do fractions. The other half, they just don't care.

Mathematics professor Dennis DeTurck, G'78, Gr'80, the newly appointed College dean and the Evan C Thompson Professor for Excellence in Teaching, does care. He cares deeply. However, his approach is, shall we say, unconventional. During a 60-Second Lecture sponsored by SAS last fall, DeTurck offered a novel approach to those pesky rational numbers. "I have a simple suggestion when it comes to teaching fractions in elementary school: Don't."

Sounds like something from a disgruntled 10-year-old, right? Certainly not a 22-year veteran of the math department, a professor with more teaching awards than Newton had theories and an accomplished classical pianist and flutist. But when it comes to math education and curriculum reform in general, DeTurck is anything but typical.

With a mischievous grin, he delivered his one-minute indictment. "Fractions have had their day, being useful for by-hand calculations of non-integers. But in this digital age, they're as obsolete as Roman numerals." What he proposed wasn't as draconian as doing away with fractions but deferring study until they're needed and can be appreciated. As he sees it, the challenge to curriculum reform is making educators lose their status-quo blinders.

When DeTurck finished his sermon on fractions, the students applauded and hooted in approval. Who can't remember, with a cringe and a sigh, the torture of having to find common denominators? Who wouldn't find the idea of teaching decimals instead of fractions appealing?

Well, DeTurck's colleagues in the math biz, for starters.

The response to his Down with Fractions lecture was staggering, especially for a webcast buried in Penn's Web site. Math bulletin boards buzzed angrily. Bloggers made sarcastic posts like "Yahoo! When something's too difficult, don't teach it." DeTurck even found himself answering irate phone calls from math professors across the country. "When was the last time you saw a .6666667-cup measure?" one Internet poster typed, "Or when was the last time you went to the fabric shop needing 3.875 yards of chintz?" DeTurck listened to the counterarguments, but after five months he remains firm. "If cooking and carpentry are the best examples you've got, then I'm right!"

Keep in mind, DeTurck is the author of 50-plus research papers and an expert on partial differential equations – math functions that describe gravitational fields, predict weather formations and create aircraft simulations. It's not that he has difficulty explaining the finer points of elementary fractions. The problem, he says, is that in grade schools "fractions are where the wheels come off for many kids." This became clear as he sat in on classes at Lea Elementary School in West Philadelphia. In one class, a student posed the question of why it was necessary to find common denominators to add fractions, but not to multiply them – "which is a great question," DeTurck emphasizes. The teacher fumbled for an answer and eventually, to the puzzlement of the students, just wrote more equations on the chalkboard. "The kids can discover some things on their own," DeTurck says, "but there's a cognitive leap that they can't bring to the table when they're 10 or 11."

BY TED MANN

"I HAVE A SIMPLE SUGGESTION WHEN IT COMES TO TEACHING FRACTIONS IN ELEMENTARY SCHOOL: DON'T."

Photo by Jon Perlmutter

DeTurck started going to Lea as director of Access Science, which teams Penn's math and science professors with local teachers to expose them to new teaching methods. The challenge is always to make abstract concepts accessible through real-world experiments – anything from measuring the Schuylkill River to quantifying the weight of food consumed in the lunchroom. But sometimes devising fun exercises isn't enough. Sometimes, says DeTurck, "the question isn't how do you teach fractions to kids, but why?"

In mathematics education, there's an abiding battle between fundamentalists, who stress memorization and formulas, and progressives, who advocate problem solving and experimentation. Every decade or so, the curriculum swings from one camp to the other: the 1960s New Math gave way to the 1980s Back to Basics, which was then challenged by the New New Math in the 1990s. It's hard to be a math teacher and not find yourself lobbying for one of these paradigms. But when pressed on where he stands in the so-called Math Wars, DeTurck just recounts the follies of each side. Arguments about math education are as passionate today as they were in ancient Greece, he points out. With a bemused historicism, he summarizes and then rejects each successive dogma. The challenge, then as now, is to find a middle ground.

What distinguishes DeTurck's ideas on curriculum reform, including his infamous fractions rant, is that they're rooted in research – specifically, the work of MetroMath, a coalition of universities studying the successes and failures of different lesson plans. Just as the teacher-training program Access Science is changing math and science education in the classroom, so too is MetroMath changing policy and curriculum outside of it. Still, it doesn't take MetroMath's $10 million research grant from the National Science Foundation to realize that, as DeTurck says, "We're still teaching math to 21st-century kids the same way that it was taught to 19th-century kids."

In higher education, the politics of curriculum reform are every bit as fractious as the Math Wars. But at Penn, where DeTurck has been one of the chief advocates of reforming the curriculum, the question was never where to draw the line but how far to push it.

"Dennis likes to be provocative," says SAS dean Rebecca Bushnell. "He likes to stir things up." One example she cites took place soon after DeTurck became chair of the Committee on Undergraduate Education (CUE), the faculty body charged with overhauling the College's two-decade-old general requirement. He had already been a critic of what he termed "requirement sprawl," but one time, Bushnell recalls, he went a step further, proposing the abolition of requirements altogether.

It was a radical notion, especially to his colleagues in the math department whose classes were already under-enrolled. "That's just Dennis," Bushnell says. "He poses these outrageous questions to get a conversation started. It gets people to think critically about why we have certain requirements – whether they're really necessary."

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DeTurck's questioning of the status quo paid off. In fall 2000, then College dean Rick Beeman launched a Pilot Curriculum in which a volunteer group of students was given a smaller core requirement, but they were expected to do research and take more interdisciplinary, team-taught courses. Most exciting to DeTurck, the Pilot was "a controlled study … something unprecedented in higher education." The *Chronicle of Higher Education* echoed his assessment in 2002: "[Penn] is proceeding in a way that should make scientists on campus proud – with a set of established variables, a control group and a willingness to be proven wrong."

The final class of the five-year study enrolled last fall, and DeTurck and CUE have started to analyze the early returns. They are looking at what Pilot students did with their newfound freedom. Did they major in the same things as other students? Did they study abroad at the same rate? The answer, it turns out, is yes. On average, students inside and outside the Pilot made the same academic choices.

While these results don't constitute a mathematical proof, something to justify a new kind of curriculum arithmetic, DeTurck did find some intriguing data. "Research was one of the biggest positives of the Pilot," he says. Even students outside the program became more involved in research projects once they realized how many opportunities there were. On the flip side, he notes, "more of the Pilot students took very low numbers of science and math courses."

April was the deadline DeTurck set for CUE to put forward a new general requirement. At the time of writing, faculty are set to vote on a new undergraduate curriculum. There's a diversity of opinion, ranging from whether to include a permanent research component to how the College might beef up its math-and-science requirement.

Managing faculty's evolving expectations while streamlining the curriculum is a lot like DeTurck's partial differential equations – complicated functions in which more than one variable changes with time. But Bushnell has total confidence. "Dennis is such a good listener," she says. "He has a unique ability to challenge people and yet, somehow, still make them feel included." DeTurck is the first to admit that he doesn't have all the answers. But as his experience with elementary schools and Penn's general requirement have shown, he's not afraid to ask the tough questions – even if they don't always yield whole numbers. ■

Faculty approved the new curriculum on April 19. DeTurck's 60-Second Lecture, Down with Fractions, can be viewed at http://www.sas.upenn.edu/home/news/multimedia_60sec.html

Ted Mann, C'00, wrote about anthropologist Clark Erickson in the spring 2004 issue.