

**Algebra Requirement Debates**

**Andrew Hacker, professor of political science, City University of New York, *New York Times*, July 28, 2012**

A TYPICAL American school day finds some six million high school students and two million college freshmen struggling with algebra. In both high school and college, all too many students are expected to fail. Why do we subject American students to this ordeal? I’ve found myself moving toward the strong view that we shouldn’t.

My question extends beyond algebra and applies more broadly to the usual mathematics sequence, from geometry through calculus. State regents and legislators — and much of the public — take it as self-evident that every young person should be made to master polynomial functions and parametric equations.

There are many defenses of algebra and the virtue of learning it. Most of them sound reasonable on first hearing; many of them I once accepted. But the more I examine them, the clearer it seems that they are largely or wholly wrong — unsupported by research or evidence, or based on wishful logic. (I’m not talking about quantitative skills, critical for informed citizenship and personal finance, but a very different ballgame.)

This debate matters. Making mathematics mandatory prevents us from discovering and developing young talent. In the interest of maintaining rigor, we’re actually depleting our pool of brainpower. I say this as a writer and social scientist whose work relies heavily on the use of numbers. My aim is not to spare students from a difficult subject, but to call attention to the real problems we are causing by misdirecting precious resources.

The toll mathematics takes begins early. To our nation’s shame, one in four ninth graders fail to finish high school. In South Carolina, 34 percent fell away in 2008-9, according to national data released last year; for Nevada, it was 45 percent. Most of the educators I’ve talked with cite algebra as the major academic reason.

Algebra is an onerous stumbling block for all kinds of students: disadvantaged and affluent, black and white. In New Mexico, 43 percent of white students fell below “proficient,” along with 39 percent in Tennessee. Even well-endowed schools have otherwise talented students who are impeded by algebra, to say nothing of calculus and trigonometry.

California’s two university systems, for instance, consider applications only from students who have taken three years of mathematics and in that way exclude many applicants who might excel in fields like art or history. Community college students face an equally prohibitive mathematics wall. A study of two-year schools found that fewer than a quarter of their entrants passed the algebra classes they were required to take.

Another dropout statistic should cause equal chagrin. Of all who embark on higher education, only 58 percent end up with bachelor’s degrees. The main impediment to graduation: freshman math. The City University of New York, where I have taught since 1971, found that 57 percent of its students didn’t pass its mandated algebra course. The depressing conclusion of a faculty report: “failing math at all levels affects retention more than any other academic factor.” A national sample of transcripts found mathematics had twice as many F’s and D’s compared as other subjects.

Nor is it clear that the math we learn in the classroom has any relation to the quantitative reasoning we need on the job. [John P. Smith III](http://jsmith.wiki.educ.msu.edu/Vitae), an educational psychologist at Michigan State University who has studied math education, has found that “mathematical reasoning in workplaces differs markedly from the algorithms taught in school.” Even in jobs that rely on so-called STEM credentials — science, technology, engineering, math — considerable training occurs after hiring, including the kinds of computations that will be required. Toyota, for example, recently chose to locate a plant in a remote Mississippi county, even though its schools are far from stellar. It works with a nearby [community college](http://topics.nytimes.com/top/reference/timestopics/subjects/c/community_colleges/index.html?inline=nyt-classifier), which has tailored classes in “machine tool mathematics.”

A skeptic might argue that, even if our current mathematics education discourages large numbers of students, math itself isn’t to blame. Isn’t this discipline a critical part of education, providing quantitative tools and honing conceptual abilities that are indispensable — especially in our high tech age? In fact, we hear it argued that we have a shortage of graduates with STEM credentials.

Of course, people should learn basic numerical skills: decimals, ratios and estimating, sharpened by a good grounding in arithmetic. But a definitive analysis by the Georgetown Center on Education and the Workforce forecasts that in the decade ahead a mere 5 percent of entry-level workers will need to be proficient in algebra or above. And if there is a shortage of STEM graduates, an equally crucial issue is how many available positions there are for men and women with these skills. A January 2012 analysis from the Georgetown center found 7.5 percent unemployment for engineering graduates and 8.2 percent among computer scientists.

What of the claim that mathematics sharpens our minds and makes us more intellectually adept as individuals and a citizen body? It’s true that mathematics requires mental exertion. But there’s no evidence that being able to prove (x² + y²)² = (x² - y²)² + (2xy)² leads to more credible political opinions or social analysis.

I WANT to end on a positive note. Mathematics, both pure and applied, is integral to our civilization, whether the realm is aesthetic or electronic. But for most adults, it is more feared or revered than understood.

I hope that mathematics departments can also create courses in the history and philosophy of their discipline, as well as its applications in early cultures. Why not mathematics in art and music — even poetry — along with its role in assorted sciences? The aim would be to treat mathematics as a liberal art, making it as accessible and welcoming as sculpture or ballet. If we rethink how the discipline is conceived, word will get around and math enrollments are bound to rise. It can only help. Of the 1.7 million bachelor’s degrees awarded in 2010, only 15,396 — less than 1 percent — were in mathematics.

I’ve observed a host of high school and college classes, from Michigan to Mississippi, and have been impressed by conscientious teaching and dutiful students. I’ll grant that with an outpouring of resources, we could reclaim many dropouts and help them get through quadratic equations. But that would misuse teaching talent and student effort. It would be far better to reduce, not expand, the mathematics we ask young people to imbibe.

Yes, young people should learn to read and write and do long division, whether they want to or not. But there is no reason to force them to grasp vectorial angles and discontinuous functions. Think of math as a huge boulder we make everyone pull, without assessing what all this pain achieves. So why require it, without alternatives or exceptions? Thus far I haven’t found a compelling answer.