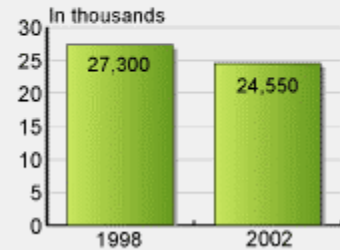


## Brain drain?

The number of science and engineering Ph.D.s earned by students at U.S. universities has been on the decline in recent years.



Source: National Science Foundation



## Brain drain in tech's future?

By [Ed Frauenheim](#)

CNET News.com

August 6, 2004, 4:00 AM PT

URL: <http://zdnet.com.com/2100-1104-5299249.html>

**John Miano's career course is the sort of thing to make tech industry leaders wince and worry about their future work force.**

Miano was a programmer who tried for years to get into computer science doctoral programs. Despite earning a "B" average in college and publishing two technical books, he never was accepted. So he took the law school admission test and promptly won a full scholarship to Seton Hall. The result: one less computer scientist, one more lawyer.

News.context

### What's new:

Every year, fewer people are earning doctoral degrees in science and engineering at U.S. schools. Will American innovation cease? Will foreigners take over? Is the sky falling?

### Bottom line:

It might not be a crisis--so far--but some analysts say more Ph.D.s would help keep the country on top. Paying scientists better would be one way to jump-start those doctoral admissions.

Discussion about technology's future in the United States often centers on problems that eighth graders have in algebra. But there also are concerns that the country's universities are churning out fewer tech-related doctorates, and that the numbers may decline further thanks to fewer foreign doctoral degree candidates--who earn a large portion of science and engineering doctorates at U.S. schools.

Two years ago, 24,550 science and engineering doctorates were earned by students attending U.S. universities. That was down from slightly more than 25,500 in 2001 and from a peak of 27,300 in 1998, according to data from the [National Science Foundation](#). More recently, a survey by the Council of Graduate Schools found a 32 percent decrease in applications from international students to U.S. graduate schools for the fall.

Analysts offer different explanations for the drop, ranging from declining interest in the sciences

among Americans to a temporary shift in the labor market and to financial disincentives to pursue doctorates in science and engineering.

The trend doesn't worry everyone. Some observers argue that the country already has plenty of Ph.D.s and that a drop in foreign doctorate students isn't cause for alarm. In fact, some view the influx of foreigners as a source of trouble--such as low salaries for scientists and fewer grad school openings for Americans.

But others, including computer industry leaders, defend the use of foreign talent and suggest the drop in doctoral degrees is a sign the country's [tech leadership](#) may be in jeopardy. Intel CEO Craig Barrett has weighed in on the issue to say that "the U.S. is basically complacent" about education and research.

The [National Science Board](#), an independent body that advises Congress and oversees the NSF, recently warned of a "troubling decline" in the number of U.S. citizens studying to become scientists and engineers, even as the number of jobs requiring science and engineering training grows.

"These trends threaten the economic welfare and security of our country," the board concluded.

[James Foley](#), chairman of the Computing Research Association and a professor at the Georgia Institute of Technology's College of Computing, sees the drop in doctorates as one of several red flags in the U.S. research system. "We have potentially big problems ahead of us if we don't pay attention," he said.

Not only is Foley concerned about doctoral degree production, he wants an increase in the amount of federal money spent on computer science research. According to a recent analysis by the American Association for the Advancement of Science, all research and development funding agencies in the federal government apart from the Defense and Homeland Security departments face flat funding overall for next year.

### **History lessons**

The idea that the United States isn't preparing enough tech-related doctorates isn't new. In 1989, the NSF warned of a coming shortfall in both Ph.D.s and bachelor's degrees in the natural sciences and engineering.

But critics have dismissed such forecasts as off the mark. "Despite recurring concerns about potential shortages of (scientific, technical, engineering and mathematics) personnel in the U.S. work force, particularly in engineering and information technology, we did not find evidence that such shortages have existed at least since 1990, nor that they are on the horizon," concludes a recent report from the [Rand](#) think tank.

Even so, no one disputes the NSF's latest numbers about science and engineering doctorates. Between 1998 and 2002, the number of science and engineering doctoral degrees awarded to U.S. citizens at U.S. institutions fell 11.9 percent to 14,313, according to the [Commission on Professionals in Science and Technology](#), a nonprofit research group.

**"If we're not leading the charge or at least creating innovation here, we're going to really be up the creek."**

--James Foley, professor,  
Georgia Institute of Technology

The number of doctoral degrees conferred in most other fields remained roughly the same in 2002, and has hovered around 15,400 annually since 1998, the NSF said.

The United States has become more dependent on foreigners for its most-educated positions in science and engineering. Between 1990 and 2000, the proportion of foreign-born people with Ph.D.s in the science and engineering labor force rose from 24 percent to 38 percent, according to the NSF. However, the pipeline of foreign talent has been shrinking. The U.S. State Department issued 20 percent fewer visas for foreign students in 2001 than in 2000, and the rate fell further between 2001 and 2002, according to the

National Science Board.

According to the National Science Board, other countries are doing more to attract the best brains to their universities. The board also said increased security restrictions are partly behind a slower pace of visas given to students and science and engineering workers since Sept. 11, 2001. [Norm Matloff](#), professor of computer science at the University of California at Davis, says students from abroad are less drawn to America because the country's job opportunities in technology have withered.

"The overriding reason most foreign students in science and engineering have come to U.S. graduate programs is not the education, but rather the fact that that U.S. education would lead to a U.S. green card, which in turn would lead to a good U.S. job and a nice material living," Matloff said in an e-mail. "In other words, no tech job market, no foreign students."

### **Is it the money, smarty?**

As for why U.S. students aren't going after doctorates as they used to, one need merely follow the money, suggests Eric Weinstein, who has [analyzed the issue](#) of high-tech labor for the National Bureau of Economic Research. He says Americans are shunning technology-related doctoral programs because of low wages and poor career prospects. Graduate students in science and engineering can spend five to 10 years earning their doctorates, all the time scraping by on \$15,000 to \$20,000 annually, he said. Many who earn their degree then end up in postdoctorate research fellowships, which may mean a salary of \$30,000.

According to Weinstein, the NSF's own data and analysis indicate that wages for graduate students and doctoral students have been kept artificially low through immigration rules that allowed for a deliberate "glutting" of the scientific labor force. He estimates that a true market wage for graduate students who teach or do research would be \$40,000 to \$60,000 per year, while many newly minted doctorates should be earning as much as \$100,000.

Weinstein isn't alone in suspecting financial reasons behind Americans' aversion to doctoral programs. A [2000 study](#) from the nonprofit National Research Council found disincentives to pursuing advanced degrees in computer science for U.S. students, at least in the short term. The study concluded that someone taking five years to earn a doctorate in computer science--without having to pay tuition or fees--would need about 50 years to catch up in career earnings with someone who goes to work immediately with a bachelor's degree in the field.

Not everyone agrees that Americans are turning away from science to snag more dough. People "don't go into science and engineering to make a lot of money," said Eleanor Babco, executive director of the Commission on Professionals in Science and Technology. "They go in because they love science and engineering."

Another school of thought holds that overall U.S. doctoral production is related to swings in the

economy. According to this view, the recent drop in doctorates may stem from the economic boom of the 1990s, with people choosing better-paying jobs in the private sector over graduate study. Rand analyst Donna Fossum suggested the downturn around 2000 may have prodded would-be workers back into doctorate programs in a similar fashion.

Indeed, NSF data shows that graduate enrollment in science and engineering programs reached a record of nearly 455,400 students in fall 2002, up 6 percent from 2001. Graduate enrollment includes both master's and doctoral students, but the statistic could signal that doctoral production is about to rise, Fossum said. "Were they people that got laid off by AOL and decided to go back to school?"

### **What's up, docs?**

There's also debate about how important those credentials are to the country's future.

Breakthroughs in computing lead to economic growth, said Georgia Tech's Foley. He noted that doctoral students at Georgia Tech are working on problems in information security and the interface between humans and computers. "If we're not leading the charge or at least creating innovation here, we're going to really be up the creek," Foley said.

Industry leaders also proclaim the importance of the doctoral degree. Computer maker Hewlett-Packard, for example, runs a summer intern program that includes about 50 doctorates and doctoral students. The company continues to hire doctorates, especially in its HP Labs research division, said Wayne Johnson, the company's executive director of university relations.

Some critics, though, doubt the country needs more PhDs. Much of the important work in technology companies can be handled with people with less training, the argument goes, and there are plenty of still-unemployed techies in the U.S. work force. What's more, the annual output of science and engineering bachelor's degrees rose steadily from 303,800 in the mid-1970s to 398,600 in 2000, according to NSF. "It's not clear to me that just looking at production of Ph.D.s is a good way of assessing innovation," said Rochester Institute of Technology public policy professor Ron Hira.

**"It's not clear to me that just looking at production of Ph.D.s is a good way of assessing innovation."**

--Ron Hira, professor, Rochester Institute of Technology

Not surprisingly, what to do about the declining doctoral numbers depends on who's talking. The National Science Board, in its recent report, called for making a priority of high-quality education in math and science.

A number of organizations have called for [visa reforms](#) to better welcome foreign students, scientists and scholars. A coalition that includes businesses and trade associations has asked Congress to reform the H-1B visa program, arguing that foreign nationals who have earned master's and doctorate degrees from U.S. universities [should be exempt from the program's annual cap](#).

Hira, though, says H-1B visas have [fueled the shift of technology work overseas](#). He suspects anxiety over science and engineering doctorates is a diversion from the offshoring trend of shifting work overseas. "There's a perception we're in a competitive crisis," he said. "The competitive and innovation (argument) has been introduced by companies that want to take offshore outsourcing off the table."

Programmer-turned-law-student Miano has a radical idea for what to do about computer science doctoral programs: Limit the ability of foreign students to attend programs in the first place. Miano, who founded the [Programmers Guild](#) activist group, argues that no more than 5 percent of students in U.S. computer science doctoral programs ought to be foreigners.

"The universities are the creators of this problem," Miano said. "They have preferred foreign students over American students."

Georgia Tech's Foley, however, argued that American students applying to computer science graduate programs aren't making the grade. "There's just not enough well-qualified U.S. students wanting to go to graduate school (in computer science)," he said.

To Weinstein, the key to convincing larger numbers of U.S. students to pursue science and engineering doctorates rather than law or business careers is better pay and career prospects. His own career follows this logic. After earning a doctorate in mathematics from Harvard and a fellowship at the Massachusetts Institute of Technology, he went on to a more lucrative job as the director of quantitative research at a financial services firm, Strativarius Capital Management.

Weinstein would boost wages for graduate students and scientists funded by national research institutions such as the National Institutes of Health and National Science Foundation--positions that are likely to be protected from the shift of tech work overseas.

"Pay scientists the six-figure salaries the market is demanding," Weinstein said, "and you will watch people come out of the woodwork in droves."

