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The STEM Crisis: Reality or Myth?

By Michael Anft

It's an acronym that has morphed into a meme.

For the United States to maintain its global supremacy in innovation, the commonplace goes, the nation must crank out more and more college graduates in STEM programs—science, technology, engineering, and mathematics. Otherwise a continuing shortage of workers in those fields will sink the nation and its economy beneath the surface of an ever-flatter world, overrun by lower-paid foreigners who have outpaced us in STEM education.

Behind the hand-wringing sits the very real question of where the next wave of American jobs will come from. After a long span of consistent job growth, from 1961 to 2001, the market in the United States for all workers has stalled for the past decade, according to the U.S. Department of Labor. It now contains roughly the same number of jobs as it did a dozen years ago.

Despite STEM workers' making up less than 6 percent of the current American work force, according to the U.S. Department of Commerce, STEM education offers a route—perhaps the one true path—out of that unemployment swamp, and will make the nation more competitive to boot, or so say a flock of education experts, pundits, and policy makers—right up to the White House. A council set up by President Obama has called for one million new STEM graduates and 100,000 new teachers in those fields over the next decade.

But is the mantra true? Are there too few well-trained Americans for the high-skilled research and manufacturing jobs available stateside?

Most researchers who have looked into the issue—those who don't

receive their money from technology companies or their private foundations, anyway—say no. They cite figures showing that the STEM-worker shortage is not only a meme but a myth.

Yes, some information-technology workers are enjoying raises, and petroleum engineers, in demand because of the boom in fracking, are seeing their salaries explode.

But if you're a biologist, chemist, electrical engineer, manufacturing worker, mechanical engineer, or physicist, you've most likely seen your paycheck remain flat at best. If you're a recent grad in those fields looking for a job, good luck. A National Academies report suggests a glut of life scientists, lab workers, and physical scientists, owing in part to over-recruitment of science-Ph.D. candidates by universities. And postdocs, many of whom are waiting longer for academic spots, are opting out of science careers at higher rates, according to the National Science Foundation.

Unemployment rates within STEM fields generally, while lower than the overall unemployment rate of 7.2 percent, are often higher than they've been in years—a sign that there is a shortage of jobs, not workers.

"Most of the claims of such broad-based shortages in the U.S. STEM work force come from employers of STEM personnel and from their lobbyists and trade associations," says Michael Teitelbaum, a Wertheim Fellow in science policy at Harvard University and a senior adviser at the Alfred P. Sloan Foundation. "Such claims have convinced some politicians and journalists, who echo them."

As do leaders of colleges and universities. Many of their institutions, of course, benefit from STEM-related partnerships with industries and federal STEM grants. Higher education receives about half of the total federal STEM education budget of $3.1-billion, according to the National Science and Technology Council. Colleges get grants from 14 agencies, including NASA and the National Science Foundation, to increase the number of STEM majors and grads, improve curricula, and bring more women and minority students into science and technology fields.

Master's-degree STEM slots also draw the international students whose tuition so many research universities rely on, and institutions hire postdoctoral workers to run labs. What's more, research universities look primarily to their hard-sciences and engineering departments to stoke their commercialization efforts and technology-transfer offices. Without strong STEM departments and a savvy research-and-innovation apparatus, such universities will see their status as economic engines diminished.

For all those reasons, the STEM-worker issue has been a hot topic on campuses lately. (As well as in Congress: The matter of opening up more visa slots for foreign tech workers was a much-debated skirmish during the battle over comprehensive immigration reform this past spring and summer.)

But if there truly were an across-the-STEM-spectrum labor shortage, Mr. Teitelbaum and others note, we'd be seeing an overall rise in wages in technology and science fields. And that isn't happening.

Ron Hira, an associate professor of public policy at the Rochester Institute of Technology who frequently testifies before Congress, has argued that companies, including Microsoft, have advocated for more federal money for STEM education and more visas for foreign IT workers—even as they lay off thousands of American employees with comparable skills. "The Washington consensus is that there is a broad-based shortage of STEM workers, and it's just not true," he says.

Others also see something nefarious behind the crisis rhetoric.

"This is all about industry wanting to lower wages," says Norman S. Matloff, a professor of computer science at the University of California at Davis. Mr. Matloff has investigated how IT employers benefit by raising the numbers of lower-paid foreign STEM laborers and by sending offshore the engineering and STEM manufacturing jobs of mostly older American workers. "We have a surplus of homegrown STEM workers now," he says. "We've had it in the past and we're likely to have it in the future."

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Taryn Kaufman, who earned a B.S. in engineering physics from Ohio State University in May, found the job market much tougher than she had expected. She attended dozens of job interviews and moved from Ohio to Boston, where her training in developing lasers might be more marketable. But for months she was told that the defense industry wasn't hiring because of sequestration, or that companies weren't interested in her academic research. Last week, as tens of thousands of dollars in student loans came due, she got an offer from Boeing.

"I've heard from people all over the country who say it's very difficult to get the first job," Ms. Kaufman says. "A lot of people are forced to take jobs as lower-paid technicians, if you can find one. It's getting harder and harder to break in."

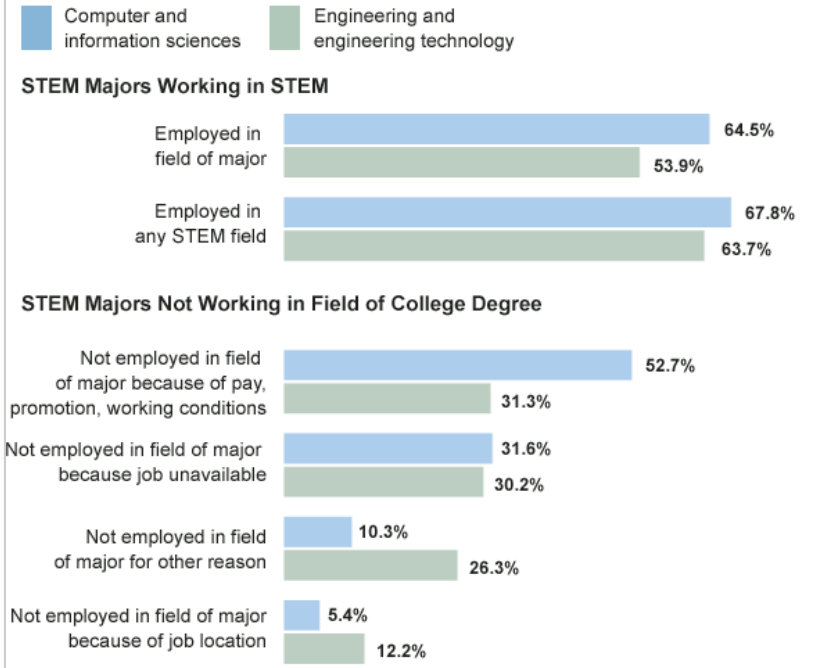
The bulk of homegrown STEM employees do not even hold STEM degrees—some 36 percent of IT workers do not have a college degree at all, according to an analysis of National Center for Education Statistics data done for the Economic Policy Institute. Meanwhile, our educational system churns out so many qualified people in STEM majors that about half of them have left the field within 10 years, according to a Georgetown University study. Many don't wait that long. Professors even at august research institutions report seeing many of their brightest minds in the hard sciences flee to Wall Street after being wooed by recruiters from financial companies.

"There's this off-the-record belief" among those claiming a worker shortage, says Mr. Matloff, "that STEM students can make a good bit of money in law, business, and finance, and that they'd have to be crazy to take STEM jobs."

A Debate: Job Outcomes in 2 STEM Disciplines

An Economic Policy Institute study of data from the National Center for Education Statistics argued that too few jobs exist for the STEM graduates entering the market. The Information Technology & Innovation Foundation shot back with its own report, calling the institute's study "misleading." For one thing, the foundation said, STEM graduates are doing better than college graduates as a whole.

EPI'S ANALYSIS



Note: Lead author was Hal Salzman, a Rutgers U. professor

Source: Analysis for Economic Policy Institute of National Center for Education Statisics (2013)

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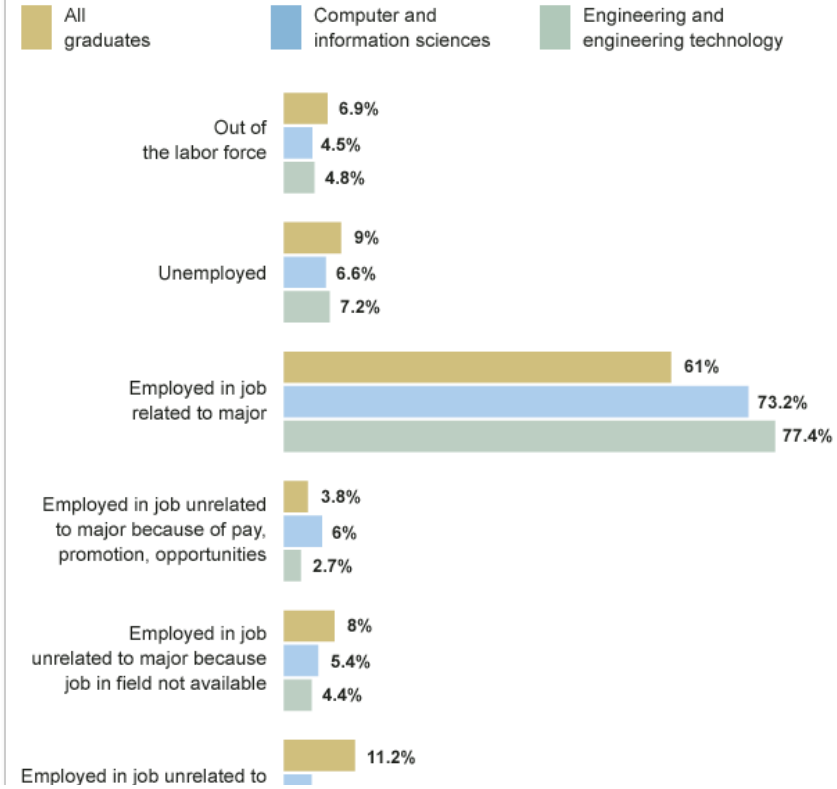

And yet, in its way, that belief supports calls for more STEM education, other researchers and university leaders point out. Educating people to become tech-savvy can benefit them in non-STEM ways, such as by preparing them for jobs that require an understanding of how complicated things work.

"STEM majors, no matter where they work, in STEM fields or out, do better than other types of majors and tend to move into management pretty quickly," says Anthony Carnevale, a research professor and director of Georgetown University's Center on Education and the Workforce, which has published papers that point to a shortage of STEM grads. "Having experience in technical matters helps them land good non-STEM jobs. They might work in places like marketing or medical-device sales, where their technical backgrounds helped them get in."

So, even if there were no STEM worker shortage, it still might be a good idea to graduate more science and tech majors?

"That's about it," says Mr. Carnevale. "You have to produce STEM workers like crazy just to have enough of them in the work force. Unemployment rates for grads in those fields are lower than the overall national average for college graduates"—3.4 percent for computer and math grads, compared with an aggregate figure of 4 percent for all college grads, according to the Department of Commerce—so "STEM is still a place you go where you have a pretty good shot. But we don't want to overdo it. You don't want to pump a bunch of people out there who, in the end, have nothing to do."

At the postdoctoral level, the oversupply of low-salaried, perpetual lab workers is well documented. "Nowadays postdocs make much less money and have to do it for longer," says Andrew DuFresne, who graduated from the Johns Hopkins University with a Ph.D. in cellular and molecular biology and biochemistry in March but has yet to find a full-time job in his field. He tutors high-school students on the fly, even as his $70,000 student-loan debt comes due. Recently he has put his energy into finding work in health policy.

"Cuts in federal research funding have led people to think of other

ways to make a living," says Mr. DuFresne, who helped develop cancer therapies as a doctoral student. "There's an assumption among mentors and others at universities that students will follow them into academia and the bench, but it isn't all that attractive. I see friends going into business and getting $80,000 to start. It's frustrating." Postdocs on average earn $46,000 per year, according to federal statistics.

Some who oversee college science and math programs say there's more to the question than how STEM grads are faring today, when unemployment rates for all 2013 grads hover around 8 percent. They point to signs of a future that calls for more American technology workers, entrepreneurs, and teachers.

"We've been able to rely in the past on students who came from around the world to study here and then work in STEM jobs here," says Irma Becerra-Fernandez, vice president for engagement at Florida International University. A growing percentage of STEM graduate students in the United States are from other countries, she notes. "We can't count on them now as we did before, because there are more opportunities for them to work in their countries of origin."

Indeed, a July 2011 report by the Commerce Department projected that by 2018, STEM jobs would grow by 17 percent. But skeptics say that, given the uncertainties of the global economy, there is no guarantee that those will be jobs in the United States, filled by American graduates.

Even so, the entrepreneurial push that people working in the sciences, engineering, and technology can give the economy is another factor cited by those who favor efforts to increase the numbers of STEM grads. The more Americans there are who are able to think about creating new, economically disruptive methods and products, the more likely the United States is to produce them.

"There's no question that to keep our innovative edge, we need more people coming into technology fields," says Robert D. Atkinson, president of the Information Technology & Innovation Foundation, an advocacy group that receives the bulk of its

funding from tech companies. It urges the federal government to widen the so-called STEM pipeline from school to work.

The wage issue shouldn't be used to discredit the idea of a worker shortage, Mr. Atkinson believes: "Companies can go overseas for workers, so wage growth in the U.S. is more limited." There will be work in IT for people with the right set of skills, he says, adding that lower wages probably won't keep them from accepting jobs.

With the aim of getting the worker pipeline flowing, Mr. Atkinson promotes educational ideas that he says could lead to more marketable innovations, like combining college engineering programs with business schools, and increasing financial support for people studying for science Ph.D.'s back to the levels of a decade ago.

He applauds universities that, having responded to various studies on how best to retain STEM students, encourage their faculties to get more freshmen and sophomores into the lab. Such moves could reduce the rate at which students change their majors and fail to get STEM degrees, now about 40 percent.

"If you reduced the switch-out by just 50 percent, you'd solve the shortage problem," Mr. Atkinson says.

He also makes less modest proposals—ones that echo the United States' longtime love affair with machines and material progress. That includes a desire to funnel college students into what he calls "more useful" majors.

"We should be making some value judgments on what kind of people we'll need for the nation to move forward," Mr. Atkinson says. "The distribution of degrees right now is entirely up to students. Shouldn't we be steering them into degree types that are of more value to society, such as computer science or engineering? The American tradition is one of hard-core pragmatism. We're at risk of losing that, and we're in trouble now in regards to competitiveness."

That line of reasoning may rhyme with something you've heard before. Americans, or at least their business leaders

and politicians, have recurrently worried that the country will lose its scientific supremacy, rendering it a second-class nation.

At each turn, those sounding the alarm tout a uniquely American hands-on, can-do ethos that will steer us clear of our pending demise. Invariably, more STEM labor and more applied science-and-math education have been prescribed for a national crisis that now seems to occur at least every generation.

Before Americans were pulling their hair over threats from China and India to our pre-eminence as a global innovator, there were ruckuses caused by an increase in foreign auto and electronics imports (Japan) in the 1970s and 80s, a fear that someone else (the U.S.S.R.) would win the space race in the 50s and 60s, and the wartime emergency (Nazi Germany) that led to the Manhattan Project in the 40s.

The pedestal placement of science and technology in the United States may go back even further. The federal Morrill Act of 1862 created land-grant colleges in most states and shifted the emphasis of higher education away from the study of classics and toward "real world" studies, including agriculture, home economics, and "the mechanical arts." Nowadays many of those same colleges, like Ohio State and Purdue University, boast large engineering schools.

When private foundations and companies seek out ways to develop STEM entrepreneurs or find tech employees, they create relationships with colleges like those, as well as with private powerhouses like Stanford and the Massachusetts Institute of Technology. They often give them lots of money, as does the federal government.

The love triangle among business, colleges, and philanthropy is well earned, observers say. Tech-centered colleges have focused national energy on concrete problems and driven large segments of the economy.

"What we're seeing now is a special version of that long-held impulse toward progress—it's that impulse on steroids," says Mr. Carnevale. "We believe in the future, and in science and

technology. We all believe in the deus ex machina that will save us."

At a time when they are beset by state-budget crises, spiraling costs, and commitments to expand research, universities hope that STEM programs will save them from the scrutiny of their government and board overseers, says Mr. Matloff. "If you're a university president, what do you point to to show how well you've done? You point to the numerics: 'During my tenure, extramural research funding increased from x to y.' Our whole society has become that way."

But colleges often hire foreign grads and postdocs who cost them less money than Americans to run labs or write computer programs, he says. He and others see such practices as one of many that plague today's STEM professionals, and may be driving them away from their fields.

A recent study by the American Society for Biochemistry and Molecular Biology discovered that one in five American scientists is considering leaving the United States. Match that finding with more STEM grads, like Mr. DuFresne, seeking work in other fields, and with what Mr. Matloff calls "an ongoing brain drain" wrought from the en masse layoffs of midcareer programmers and IT professionals, and the outlook for tech-knowledgeable people isn't all that rosy.

"Does all that sound good for national competitiveness, or for the STEM job market?" he asks.

Still, recruiters at high-tech and science-based companies maintain that the current work force isn't meeting their needs. So, what gives?

Some university chiefs say the labor shortage is real. The problem is that employers and would-be workers don't always match up well, whether because of geography or a worker's level of specific skills, or because companies—merged, downsized, or otherwise hunkered down during the recession—aren't reaching out to college grads and others effectively enough.

"The matching system is antiquated," says Michael Crow, president of Arizona State University, where the student body has grown from 48,000 to 75,000 in 10 years. Increasing opportunities for the study of STEM has been a major factor in that growth. Among this year's freshman class, seven of the top 10 majors are in STEM fields, with biology at the top.

Arizona State has begun to develop a program in which employers can get to know students long before graduation by presenting them with problem-solving challenges. The idea is one of many that institutions are hatching to improve job placement.

But those efforts may not be enough."When people have trouble finding a job, it may be a regional issue," says Mr. Crow. "Students need to be mobile." Still, STEM grads are typically doing well, he says: "If you ask me, there's too much reliance on anecdotes" about STEM grads floundering in the job market.

People like Michael Teitelbaum say that universities are falling down on the job of informing students of their STEM career prospects. Other observers say that it's not colleges' job to train people for work in narrow fields, much less to place them in jobs, or to forecast how well they'll do. That's impossible, they say. Some types of work may not be around in a few years, anyway, as innovation changes the nature of research and manufacturing. Other jobs not yet envisioned will—it is hoped—fill the void.

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All of which makes the debate over the need for STEM workers even more of a muddle. Should colleges prepare more people for a specific subset of work that may soon be obsolete, or create well-rounded STEM thinkers? Is emphasizing one type of education over another enough to keep the United States the leader in technology? Is focusing solely on science and tech as an economic driving force dangerous?

Some experts say students need more education—of many

types—to be truly successful once they graduate. They say making sure that students develop skills that help them interact with other people, and in a creative way, would do more to foster workplaces where innovation would flourish.

"Really, combining STEM knowledge with humanities knowledge would be ideal," says David Hart, director of the Center for Science and Technology Policy, at George Mason University. "If you can train an engineer to solve problems and operate in a complicated environment, you've done something important."

Which might mean that as many institutions focus on producing graduates for a 21st-century, technology-focused job market, they shouldn't abandon a broader education that at first blush seems less practical.