The late legendary CBS journalist Eric Sevareid once wryly observed, “The biggest big business in America is not steel, automobiles, or television. It is the manufacture, refinement, and distribution of an xiet y.” Periodic ruminations over asserted shortages of science, technology, engineering, and mathematics (STEM) professionals and students are major contributors to that immensely wasteful American pastime.

A PERPETUAL CRISIS

Demographer Michael Teitelbaum recently examined five such alarmist boom–bust cycles since the end of World War II. Each cycle was preceded by frenetic claims that the US was falling behind some technological, economic, or military competitor, that the country lacked the scientific and engineering skillset to rectify its perilous position, and that only a massive, government-funded education and training effort would turn things around. In each case, considerable resources were expended to increase the pool of technical talent, primarily for the benefit of industry and academia, while the alleged crisis turned out to be a chimera.

One of the more dubious and widely reported skill-shortage claims arose in the late 1980s, when the National Science Foundation’s leadership issued a dire warning to Congress that the US would be short 675,000 or more scientists and engineers by 2006. According to distinguished economists Richard Freeman and Daniel Goroff, the NSF constructed its “bogus claims” on “extrapolations that were not based on any remotely plausible assessment of the labor market.” In addition to seeking more federal funding for science and engineering, they argued, the NSF’s underlying rationale for fudging the numbers was to “induce more young Americans into science and engineering to lower the cost of scientists and engineers to large firms.” After the NSF’s data manipulation was exposed, the next director publicly apologized, but by then the damage was done: one reason Congress authorized the controversial H-1B nonimmigrant visa worker program was that it had been convinced by the NSF that an impending high-tech skills shortage threatened to cripple America’s economy.

The US is in the throes of yet another “STEM crisis,” the severity of which depends on how STEM is defined...
Defining STEM: An Example of Interpretive Dance

According to the ominous-sounding “Gathering Storm” reports published by the National Academies of Science, Engineering, and Medicine, the country faces a severe science and engineering talent deficit that has been growing unchecked for decades.¹ The reports claim—in language expressly meant to create unease in the public’s mind—that the US won’t have a sufficiently skilled workforce to “successfully compete, prosper or be secure in the global community of the 21st century.” Most worrying, the reports add, the situation is getting worse with each passing year, and only long-term, sustained government intervention can reverse America’s impending decline.

Expanding the Anxiety Market

A late addition to the STEM anxiety business portfolio is computer science, which was legally defined as a STEM discipline in the US in October 2015 when President Obama signed into law the STEM Education Act. This law expands government support for STEM informal education and teacher training through grants and scholarships, but its main purpose is to ensure that “computer science skills are included among STEM subjects.”⁵ Congress’s near-unanimous vote for the definitional change is a testament to the persistent lobbying efforts of Code.org and other computer science education advocacy groups. These groups have long warned lawmakers that the US would be left

References

behind in the global technology race if it didn’t keep pace with other countries such as the UK, Australia, and Finland, which are or will soon be teaching computer science as a core subject.

American parents apparently have gotten the message. A 2014 Gallup poll revealed that 90 percent of parents of students in grades 7–12 think computer science classes are a good use of educational resources, and 21 percent went so far as to declare computer science more important than English, math, science, and history. Unfortunately, Gallup didn’t ask the parents which of those four subjects they thought computer science should replace.

President Obama has long encouraged aspiring young computer programmers, but in his 2016 State of the Union Address he called for every American student to be offered “hands-on computer science and math classes that make them job-ready from day one.” To show he meant business, the president proposed that $4 billion of his 2017 federal budget be used to fund new K−12 computer science programs, calling them “critical” to the US economy’s future. Disappointingly, he hasn’t yet indicated what current curricula should be reduced or eliminated to accommodate those programs. The easy targets—art, music, and language courses—have already been dramatically scaled back in American schools. Perhaps history and geography, as in Australia?7

Before deciding, the Obama administration might want to examine the current state of the UK’s national computer science education initiative. The Cameron government has instituted an independent review into why university computer science students—who have outnumbered the country’s physics, chemistry, and mathematics majors combined for the past six years—have experienced the highest unemployment rate of all STEM-related graduates for nearly a decade, despite supposedly unprecedented industry demand for their skills.8

### DIALING UP THE ANXIETY LEVEL

In his book Science, Money, and Politics, which examines how the quest for funding can easily pervert national science and technology policy, veteran science reporter Daniel Greenberg explains that one sure-fire method for ensuring a science or engineering “problem” that needs fixing (and, of course, funding) enters the public consciousness is to attach really scary numbers from a seemingly authoritative source. Once those numbers are published and picked up by the press, they take on a life of their own and are very hard to refute. As Greenberg puts it, “some numbers beat no number, every time” when trying to draw widespread attention to an issue.9

One such “frightening” number that has created much public anxiety is the US Bureau of Labor Statistics’ (BLS’) projection of computing job openings by 2022.10 As Table 1 indicates, the BLS estimates that 1.24 million such jobs will need to be filled by that date. Microsoft claimed in a widely circulated report that all of these jobs would require computer science degrees, yet the BLS expects only 400,000 Americans to earn such a degree by 2022. The company argued that overcoming this huge computer science skills gap would require both an influx of outside help (for example, H-1B visa holders) and significant government funding of STEM education.11 However, as an Economic Policy Institute memo later pointed out, Microsoft had grossly distorted the facts.12

First, not all of the jobs categorized by the BLS as computing occupations require a computer science degree. As Table 1 shows, about 945,000 of these

<table>
<thead>
<tr>
<th>Occupation category</th>
<th>STEM occupations (total)</th>
<th>Job openings due to growth and replacement needs</th>
<th>Doctoral or professional degrees needed</th>
<th>Master’s degrees needed</th>
<th>Bachelor’s degrees needed</th>
<th>Associate’s degrees needed</th>
<th>High school diploma or equivalent needed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2,749,300</td>
<td>142,400</td>
<td>26,100</td>
<td>1,886,200</td>
<td>655,500</td>
<td>39,600</td>
<td></td>
</tr>
<tr>
<td>Management occupations</td>
<td>171,400</td>
<td>–</td>
<td>–</td>
<td>171,400</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Computing occupations</td>
<td>1,240,100</td>
<td>–</td>
<td>8,300</td>
<td>944,600</td>
<td>247,600</td>
<td>39,600</td>
<td></td>
</tr>
<tr>
<td>Mathematical occupations</td>
<td>68,400</td>
<td>–</td>
<td>17,800</td>
<td>50,600</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Engineering occupations</td>
<td>694,100</td>
<td>–</td>
<td>–</td>
<td>544,300</td>
<td>149,800</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Life, physical, and social science occupations</td>
<td>361,000</td>
<td>57,300</td>
<td>–</td>
<td>157,900</td>
<td>145,800</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Postsecondary teachers</td>
<td>85,100</td>
<td>85,100</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Sales representatives</td>
<td>129,200</td>
<td>–</td>
<td>–</td>
<td>17,400</td>
<td>111,800</td>
<td>–</td>
<td></td>
</tr>
</tbody>
</table>
jobs—76 percent—are likely to require a bachelor’s degree, but according to the NSF less than half of those in computing and mathematical occupations currently have a bachelor’s or higher degree.\footnote{In addition, Microsoft conveniently overlooked NSF data indicating a pool of nearly 1 million newly graduated American engineers and mathematicians from which tech companies could draw. It also ignored the tens of thousands of people in non-STEM degree fields that, according to the US Census Bureau, eventually end up in computing jobs.}\footnote{Microsoft has never corrected its misrepresentation of reality, and a simple online search reveals that other organizations continue to repeat it.}

The Obama administration has been carefree with its STEM numbers as well. In 2012, for instance, it trumpeted the need for 1 million more students with bachelor’s and associate’s degrees in STEM subjects than are projected to graduate over the next decade, designating this goal a “Cross-Agency Priority.”\footnote{The Obama administration has been carefree with its STEM numbers as well. In 2012, for instance, it trumpeted the need for 1 million more students with bachelor’s and associate’s degrees in STEM subjects than are projected to graduate over the next decade, designating this goal a “Cross-Agency Priority.”} However, there's little publicly available quantitative analysis backing this call for a significantly larger supply of STEM graduates.

Mapping BLS-defined STEM occupations\footnote{Mapping BLS-defined STEM occupations to projected job openings by 2022, we can see in Table 1 that some 2.75 million STEM jobs of all types will need to be filled. Yet, conservatively extrapolating NSF data from 2012 on undergraduate and associate’s degrees awarded in STEM subjects without any further projected growth, we find that by 2022 there will be an estimated 2.9 million Americans and permanent US residents with bachelor’s degrees and 900,000 with associate’s degrees in STEM subjects—a total of 3.8 million graduates.} to projected job openings by 2022, we can see in Table 1 that some 2.75 million STEM jobs of all types will need to be filled. Yet, conservatively extrapolating NSF data from 2012 on undergraduate and associate’s degrees awarded in STEM subjects without any further projected growth, we find that by 2022 there will be an estimated 2.9 million Americans and permanent US residents with bachelor's degrees and 900,000 with associate's degrees in STEM subjects—a total of 3.8 million graduates.

Adding another million people with STEM degrees to the labor pool as the White House aims to do would raise this figure to 4.8 million. Plus there are tens of thousands of other potential workers in STEM occupations including legal immigrants with STEM degrees, foreigners legally eligible to work in STEM fields such as H-1B and F1 (foreign student) visa holders, and all those with non-STEM degrees that opt to work in STEM occupations. Running the numbers, it’s curious that several US senators are pushing legislation to triple the annual cap on H-1B visas from the current 65,000 to up to 195,000 as well as allow companies to hire an unlimited number of foreign students graduating from US colleges and universities with advanced STEM degrees.\footnote{Although approximately two out of five recent STEM graduates currently can’t find employment in their field of study (the ratio can be much higher for less-in-demand STEM degrees), many economists don't find this troubling. For example, Nicole Smith of Georgetown University says maintaining an oversupply of STEM graduates is a worthy national strategy "because they will end up in other sectors of the economy and be productive."}

**THE STEM ENIGMA**

Why so much governmental and corporate anxiety about a nonexistent shortage of STEM workers? To answer this question, it’s useful to recall what Winston Churchill famously called the former Soviet Union's foreign policy during the Cold War: a riddle, wrapped in a mystery, inside an enigma. The answer, I think, is also analogous to what Churchill perceived as the key to understanding that policy—namely, “national interest.”

Corporate and government self-interest in the US, as elsewhere in the world, lies in having an ample—or, better yet, excessive—quantity of well-educated STEM professionals. Given the universal belief that the nation's ability to innovate, stay economically competitive, and create good jobs is closely linked to the availability of high-quality tech workers, the more STEM graduates the better. A plentiful supply of such graduates, whether educated in the US or abroad, not only provides a larger reservoir from which to draw the “best and the brightest,” it also helps to keep the wages of high-salaried employees in check. For instance, former Federal Reserve Chairman Alan Greenspan has long promoted raising or eliminating H-1B visa caps on the grounds that it would increase productivity by “bringing in people to do the work here, rather than doing the work elsewhere” and that low caps were keeping professional salaries too high and thus creating a “privileged elite.”\footnote{Greenspan.}

This isn't to say, of course, that there aren’t spot shortages of workers with STEM skills. In fact, it would be highly worrying if there weren't, since that would mean technological innovation was slowing down or an industry was faltering. Petroleum engineering is a case in point. New extraction technology helped revive a moribund oil industry in the mid-1990s, sparking higher demand for US petroleum engineering graduates, which in turn led to higher starting salaries being offered. According to published oil and gas industry data, in 2003 the average starting salary was $55,987, whereas by 2009 it reached $86,200, averaging nearly three and a half percentage points above the 2.4 percent official average inflation rate over that period.\footnote{This matters because an average annual wage growth rate three percentage points above the rate of inflation for five years is a generally accepted economic indicator of a significant occupational skills gap.}\footnote{Data from the National Association of Colleges and Employers (www.naceweb.org) shows that the starting salary of
graduates with a bachelor’s degree in computer science averaged $67,300 for the class of 2014 and $61,287 for the class of 2015, and is projected to average $61,321 for the class of 2016—statistics hardly indicative of a massive skills shortage. Even if in some markets the demand for computing skills exceeds the available supply, any genuine shortage will eventually take care of itself. After 2009, entry-level petroleum engineering salaries closely matched the rate of inflation, signaling that the shortage of qualified workers was easing.21

Today, companies routinely complain that they can’t find proficient IT security staff. However, Thomson Reuters’ senior information security architect, Andy Boura, insists that this shortage is simply the result of offering salaries too low to attract candidates with the needed expertise or to lure computing professionals in other fields, such as software architects, to risk switching careers. Pay more, he says, “and the problem will go away.”23

Likewise, the US manufacturing industry has persistently pointed to a deficit of 600,000 workers with STEM and related skills. However, a study by the Boston Consulting Group found that manufacturing salaries have remained flat for years. As the authors observed, “trying to hire high-skilled workers at rock-bottom rates is not a skills gap.”22

Charles Steinmetz, a true giant of our field and an early president of the American Institute of Electrical Engineers, warned repeatedly against becoming too technology-focused at the expense of other educational disciplines. In 1909, he forcefully argued that “education is not the learning of a trade or profession, but is the development of the intellect and the broadening of the mind. … [L]earning of the engineering trade [alone] can hardly be called receiving an education, and certainly does not fit the man to intelligently perform his duties as citizen of the republic during the stormy times of industrial and social reorganization, which are before us.”24

Let’s take a deep breath and stop the overwrought talk about a STEM crisis and how it’s leading to the end of the American way of life as we know it. That isn’t going to happen, no matter how much the crisis is marketed using what Hal Berghel fittingly terms “STEM porn” techniques.25 Instead of being depressed, we should be joyously celebrating America’s successful recovery from its latest bout of STEM anxiety disorder.

According to the NSF’s Science & Engineering Indicators 2016 report, the number of science and engineering bachelor’s degrees awarded has reached an all-time peak.13 Student interest in computer science and other STEM disciplines is sharply rising, and undergraduate attrition is now lower than in many non-STEM majors. Assuming current trends hold, not only will the president’s goal of 100,000 additional engineers by 2022 be exceeded, there will be nearly 300,000 more engineers with bachelor’s degrees than the market demands.

It’s time to refocus our attention where it belongs: giving students an education that, yes, includes STEM, but not at the expense of the arts and humanities. We need well-rounded citizens to contribute to society and, more critically, comprehend—to borrow from Steinmetz—the stormy times of industrial and social reorganization that are before us.

If the business community truly believes that there is a STEM skills gap in the US, they can close it easily by sending the proper signal to the labor market—namely, significant pay increases. Workers and students will follow the money, just as they always have. 

REFERENCES


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