VITALSIGNS

Reports on the condition of STEM learning in the U.S.

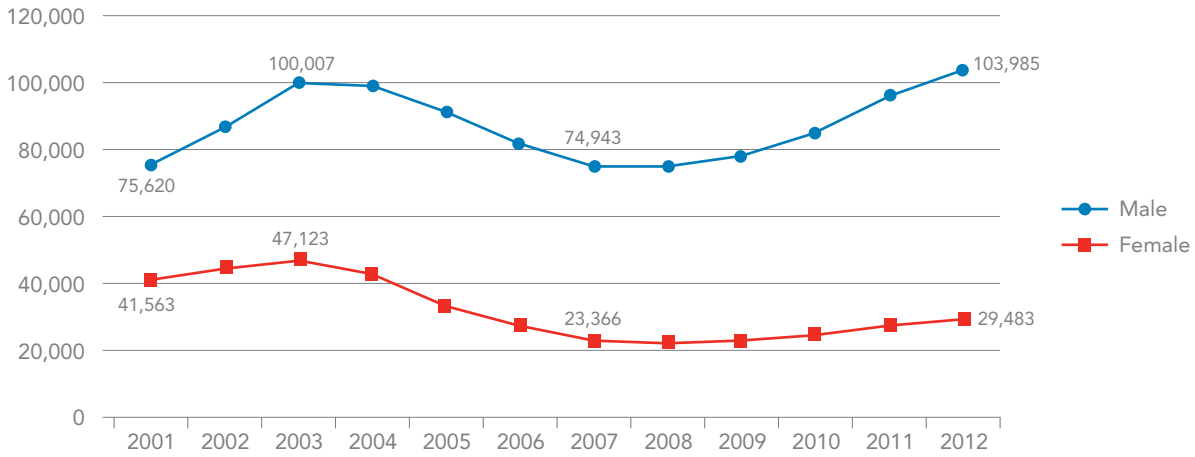
HALF EMPTY

As Men Surge Back into Computing, Women are Left Behind

Jobs in computing[1] have been a ray of light in a gloomy economy. Unemployment in the field stands at only 3.4 percent,[2] and the number of computing jobs is expected to grow more than 20 percent by 2020.[3] Many young people seem to have taken notice. After declining steeply in the mid-to-late 2000's, the number of computing degrees and certificates awarded in the U.S. has risen swiftly and almost regained the peak it attained in 2003. Is this trend a sign that the nation is tackling its shortage of talent in computer science, as some commentators have claimed?[4]

Not so fast. Change the Equation's analysis of recent data on degrees and certificates in computing reveals a far more troubling picture:[5] men have surged back into computing in the past five years, but women have not recovered from last decade's slump.

Computing degrees and certificates by gender, 2001-2012



What's the problem? Computer science and information technology are among the nation's fastest-growing occupations, and employers are struggling to fill open jobs.[6] Men alone cannot meet the demand. We cannot afford to squander the talent and insights of half the nation's population in this critical area.

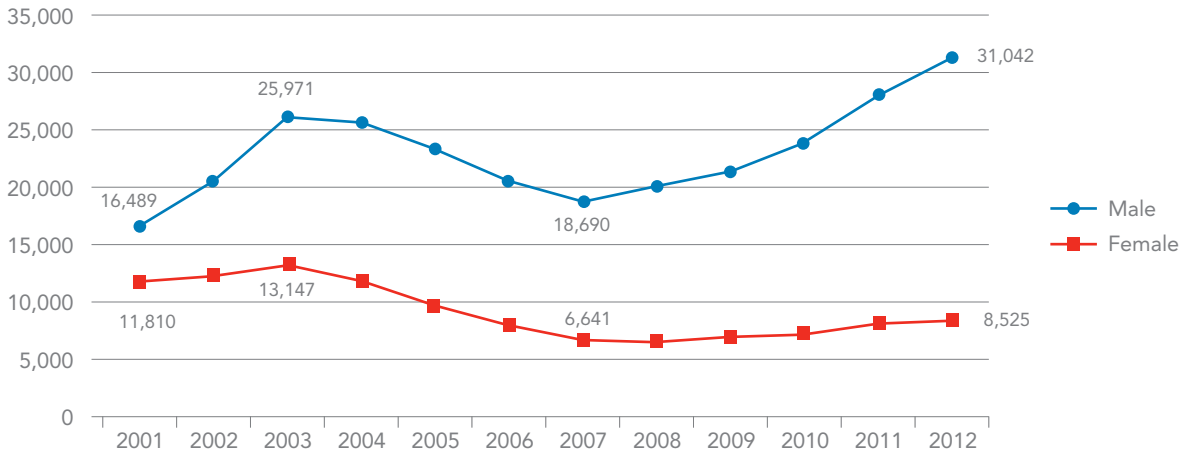
CHANGE THE EQUATION™

Women have lost ground at almost every level

The same general pattern holds for post-secondary certificates, Associate's degrees, Bachelor's degrees, and Master's degrees.[7]

It is in Associate's degrees that women have fallen the farthest, from more than 40 percent of degrees in 2001 to a mere 22 percent in 2012.

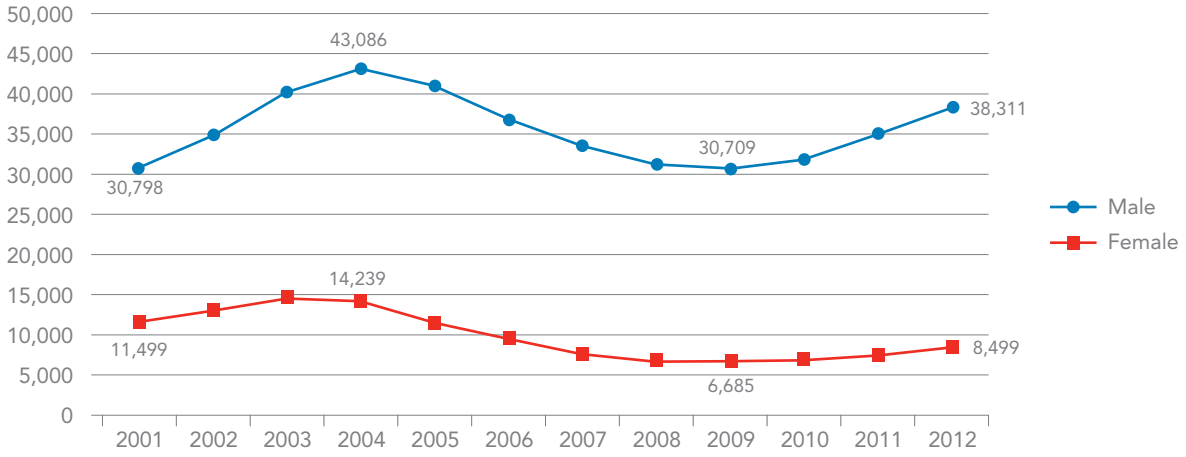
Associate's degrees in computing by gender, 2001-2012



There may be a plausible explanation for the pattern among men: marketable and relatively inexpensive two-year credentials often become more popular when economic growth stalls. In fact, Associate's degrees may have paid off: recent surveys of employers have revealed a sharp rise in demand for workers with such degrees in computing.[8] Whatever the cause of the growth in Associate's Degrees, women seem immune.

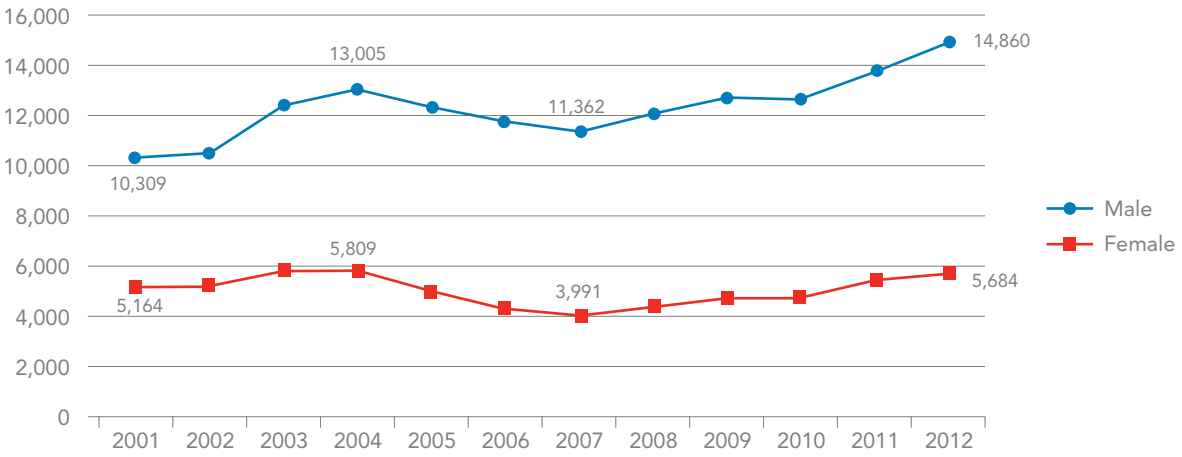
The news is almost as grim for Bachelor's degrees. In 2012, women earned a mere 18 percent of all Bachelor's degrees in computing, down from 27 percent in 2001.

Bachelor's degrees in computing by gender, 2001-2012



The decline is less dramatic, though still disheartening, in Master's degrees, where women's share fell from 33 to 28 percent between 2001 and 2012.

Master's degrees in computing by gender, 2001-2012



Employers who are looking for candidates with STEM Bachelor's degrees or higher are mostly likely to feel the talent crunch. U.S. colleges and universities awarded just shy of 70,000 Bachelor's degrees or higher in 2012—well below the average of 120,000 open jobs a year that will require such degrees.[9] Even if the current growth rates continue, degrees will fall short of demand. Women could close the gap.

What is responsible for the gap?

Most research on the decline of women in computing points to social influences. The common perception of computer science as a solitary profession can alienate girls and women. This perception is nurtured by popular culture, which depicts women in computing as odd or eccentric, if it depicts them at all. Girls often report feeling unwelcome in computer science classes and clubs, which are dominated by boys. All too often, computer science classes exacerbate the problem by presenting computing as an activity that focuses on machines rather than people while neglecting important social issues.[10]

Glimmers of hope

Isolated efforts around the country offer hope that, by building strong foundations in computing for girls in K-12, we can reverse the decline of women in computing. In the Los Angeles Unified School District, the Exploring Computer Science program deliberately recruits girls into its high school computer science classes, offers them a curriculum that addresses their backgrounds and interests, and helps teachers make their lessons more engaging and relevant. The result? Girls make up 46 percent of the program's more than 2,000 students. More recent efforts, such as Girls Who Code and Black Girls Code, combine intensive out-of-school instruction in computer science with exposure to female role models.[11] Girls who get such exposure are less likely to harbor negative views of the field.[12]

States can make a big difference

Without broader state and local policies to encourage computer science education in K-12, even the best programs for girls are swimming upstream. Only 14 states have solid high school standards for what students should know and be able to do in computer science,[13] and only 13 states and the District of Columbia allow computer science to count towards high school graduation requirements in math or science.[14] Girls suffer disproportionately in this policy vacuum, because they are much less likely than boys to take part in computing activities outside of school.

What can states do?

States can help level the playing field by taking several decisive policy actions.

- **Make computing count.** States that make computer science a high school graduation requirement ensure that all students gain exposure to computing.
- **Adopt strong computer science standards.** Required courses will have little impact if they are not aligned with standards that clearly specify relevant and engaging content and skills students should learn. The Computer Science Teachers Association has developed model standards that have won broad respect among experts in computer science.
- **Create clear pathways to teacher certification and professional development** in computer science, with a special focus on teaching girls and other underrepresented groups. State certification requirements in computer science are either deeply flawed or missing altogether,[15] and computer science teachers have few opportunities to enhance their skills. As a result, they have little guidance on how to teach in ways that truly engage girls and students of color.
- **Support programs that get girls hooked on computing.** Exploring Computer Science, Girls Who Code, and Black Girls Code are just three examples of such programs. Others include Technovation, a competition where girls work with mentors to develop new mobile apps that solve problems in their communities; and Girlstart, a set of afterschool and summer programs that give middle and high school girls hands-on experience in STEM fields like technology.[16]

We know we can get many more girls and women into computing. Thirty years ago, women earned 36 percent of all Bachelor's degrees in computer science,[17] but worsening perceptions of computing have conspired with decades of inaction to cut that percentage in half.

With smart policies and support for proven strategies, we can look forward to a time when fully half of the computing workforce is female.

1 We use the term "computing" to refer to a broad range of computer science, information technology, and other computer-related occupations or degree and certificate programs. For a similar use of this term, see Catherine Ashcraft, Elizabeth Eger, and Michelle Friend, *Girls in IT*: The Facts, National Center for Women & Information Technology, 2012. http://www.ncwit.org/sites/default/files/resources/girlsinit_thefacts_fullreport2012.pdf.

2 Microsoft Corporation, *A National Talent Strategy: Ideas for Securing U.S. Competitiveness and Economic Growth*, 2012. http://www.microsoft.com/en-us/news/download/presskits/citizenship/MSNTS.pdf.

3 C. Brett Lockard and Michael Wolf, "Occupational Employment Projections to 2020," Monthly Labor Review, January 2012, pp. 84-108. http://www.bls.gov/opub/mlr/2012/01/art5full.pdf.

4 Dice.com, *America's Tech Talent Crunch 2013*. http://marketing.dice.com/pdf/2013-05_AmericasTechTalentCrunch.pdf.

5 Change the Equation worked with the American Institutes for Research to analyze data from the U.S. Department of Education's Integrated Post-Secondary Education Data System (IPEDS). IPEDS collects data from the roughly 7,500 U.S. post-secondary institutions that participate in federal student aid programs. These institutions include public and private colleges and universities, community and technical colleges, non-degree-granting institutions, for-profit institutions, and others.

6 Microsoft, 2012.

7 Results for doctoral degrees varied greatly from one year to the next, in part because relatively few are conferred each year.

8 Phil Gardner et. al, "Recruiting Trends, 2012-2013," Michigan State University Collegiate Employment Research Institute, 2012. http://www.ceri.msu.edu/wp-content/uploads/2012/11/FRecruiting-Trends-2012-2013.pdf; Dice.com, 2013.

9 Microsoft, 2012.

10 For a useful summary of the research on women in computing, see Ashcraft, Eger, and Friend, 2012.

11 See Exploring Computer Science, http://www.exploringcs.org/, Girls who Code, http://www.girlswhocode.com/, and Black Girls Code, http://www.blackgirlscode.com/.

12 See, for example, Sapna Cheryan, Victoria C. Plaut, Caitlin Handron, and Lauren Hudson, "The Stereotypical Computer Scientist: Gendered Media Representations as a Barrier to Inclusion for Women," *Sex roles* 69.1-2 (2013): 58-71.

13 Cameron Wilson, Liegh Ann Sudol, Chris Stephenson, and Mark Stehlik, *Running on Empty: the Failure to Teach K-12 Computer Science in the Digital Age*, The Association for Computing Machinery and The Computer Science Teachers Association, 2010. http://www.acm.org/runningonempty/fullreport2.pdf.

14 The Computer Science Teachers Association, *Bugs in the System: Computer Science Teacher Certification in the U.S.*, 2013. http://csta.acm.org/ComputerScienceTeacherCertification/sub/CSTA_BugsInTheSystem.pdf.

15 The Computer Science Teachers Association, 2013.

16 Change the Equation has recognized Girlstart and Technovation (a program of Iridescent) for their quality and effectiveness. For an overview of both programs, see Change the Equation's STEMworks database of programs that have met high standards for effectiveness: http://changetheequation.org/improving-philanthropy/stemworks.

17 National Science Foundation, Women, Minorities, and Persons With Disabilities in Science and Engineering: 1996, Arlington, VA, 1996 (NSF 96-311).

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