# VITALSIGNS

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

# DOES NOT COMPUTE

## The High Cost of Low Technology Skills in the U.S.—and What We Can Do About It

Although American millennials are the first generation of "digital natives"—that is, people who grew up with computers and the internet—they are not very tech savvy. That fact would probably come as a shock to most Americans—especially to millennials themselves. After all, millennials are glued to their phones, tablets, and other devices. Many assume that using technology *often* means using it *well*.

Yet this belief is fueling a sense of complacency that endangers the nation's future. Using technology for social networking, surfing the web, or taking selfies is a far cry from using it to solve complex problems at work or at home. Truly tech savvy people are able to fulfill the promise of technology, which is to help us be more productive, accelerate innovation, and overcome seemingly intractable challenges. What millennials don't know about their tech skills is costing them dearly.

Change the Equation's analysis of results from the 2012 Programme for International Assessment of Adult Competencies (PIAAC—see sidebar on next page) reveals sobering new data on millennials' skills and attitudes. The findings offer clear lessons for anyone who cares about the future of our children. Young people won't acquire higher tech skills by osmosis—we can and should consciously promote these skills in school and beyond. Already, proven and promising programs are doing just that.

### High tech, low skills

Millennials spend on average 35 hours per week on digital media,[1] yet CTEq's analysis finds that 58 percent have low skills in solving problems with technology. In fact, an international comparison of millennials' performance on PIAAC's technology test ranked the United States dead last out of 19 participating countries.[2]

What does it mean to have low skills? PIAAC ranks each test taker at one of four skill levels: Below Level 1, Level 1, Level 2, and Level 3. Research identifies Level 2 as a "minimum standard" for access to professional and social benefits.[3] People who score below Level 2 would not be able to solve a problem whose solution takes several steps and requires a small number of computer applications. For example, they might have trouble locating specific information on a spreadsheet by sorting rows or columns and then emailing that information to the person who requested it. Those who score Below Level 1, as 19 percent of millennials do, would have trouble sorting email responses to a party invitation into pre-existing folders to keep track of who can and cannot attend.[4]

Truly tech savvy people are able to fulfill the promise of technology, which is to help us be more productive, accelerate innovation, and overcome seemingly intractable challenges.

CHANGE THE EQUATION™

### Examining millennials' tech skills with PIAAC

Change the Equation analyzed results from the 2012 Programme for International Assessment of Adult Competencies (PIAAC), a test of adults aged 16–64 in 24 developed countries. CTEq focused on "problem solving in a technology-rich environment," which is the ability to use digital technology, communication tools, and networks to solve practical problems. We paid special attention to test takers who were between 16 and 34 years old, an age span that roughly captures millennials, who were born between late 1970s and the mid-1990s. We aimed to test the widespread assumption that millennials are tech savvy and measure the impact of their technology skills on their career prospects. (See *www.changetheequation.org* for more on the methodology.)

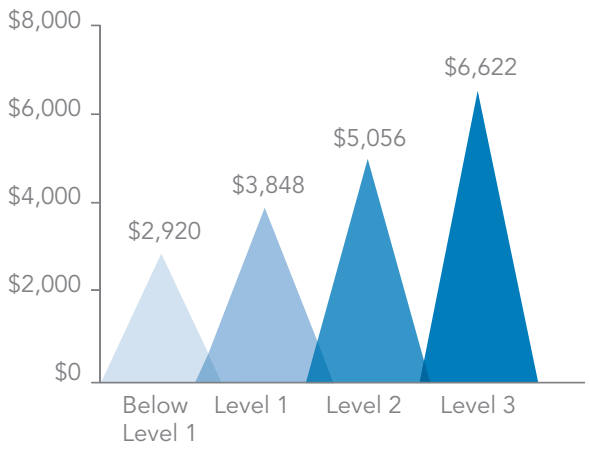
Millennials do perform somewhat better than their elders—70 percent of the 35–64-year-old set have low skills—but that's cold comfort, given that technology's influence on the workplace will only grow in the coming decades.[5]

## The high cost of low skills

Chances are, millennials' lack of tech savvy has already affected their job prospects. CTEq's analysis of PIACC finds that a person at the highest skill level is likely to earn far more than double what a person at the lowest level earns.

These benefits hold up even when other characteristics that affect earnings are held constant. On average, a person at the highest technology skill level earns almost 40 percent more than someone at the lowest level, *even if* both people are of the same gender, race, and education level and have roughly the same literacy and numeracy skills. These results confirm that using technology to address challenges has become a defining characteristic of work in the 21st century. According to recent research, for example, 80 percent of middle-skill jobs, which generally require less than a bachelor's degree, require tech skills—and that share is growing.[6]

### Average monthly earnings by skill level




## What they don't know *can* hurt them

Millennials seem largely unaware that their low skills in solving problems with technology could be stunting their careers. According to CTEq's analysis of PIAAC, fully 91 percent say they do not believe a lack of computer skills has affected their chances of being hired, promoted, or given a raise—including 76 percent of millennials who scored Below Level 1 and 92 percent of those who scored at Level 1.

That amounts to *13 million* low-skilled young Americans who simply do not grasp the high price they are paying for their poor skills. Employers have noticed, however. In a recent survey only 37 percent of employers found that recent college graduates are well prepared to stay current on new technologies.[7] And economists argue that wage differences are a clear signal of the demand—and the shortage—of tech problem-solving skills. At a time when millennials' struggles to gain a foothold in the middle class through gainful employment are grabbing headlines,[8] their lack of tech savvy could be a largely unexamined culprit.

## Teach the children well

Continued blindness to this problem could exact a steep toll on the nation as a whole. If we simply leave young people to their own devices—quite literally—their low skills will become a dead weight on individual opportunity and American productivity. Poor digital skills already cost companies many billions of dollars each year.[9]

We must make a point of incorporating technology into how students learn to tackle problems. This does not mean that every young person needs to become a computer scientist, though more certainly should. Instead, students must learn to realize the full potential of technology as a critical aid to human productivity and invention.

This is no small task. Schools and communities need better technical infrastructure, for example, and teachers need training. Yet excellent education programs, both in and beyond schools, are showing the way forward.

## Programs blazing a trail

Change the Equation has identified effective STEM education programs that prove it is possible to teach young people to be tech savvy. These programs are in STEMworks, CTEq's prestigious honor roll of STEM education programs that have stood up to rigorous third-party reviews of their effectiveness. They are not the nation's only successful programs, but they do embody the kinds of technology experiences that should become business as usual in our nation's schools and out-of school programs.

## Lessons for all of us

These successful STEMworks programs convey important lessons.

**Use technology to solve real-world challenges.** It is all too easy to think that a laptop in every backpack or a tablet in every hand will in itself yield a tech-savvy nation, but we have far too many examples of ambitious technology initiatives that wasted millions on hardware without any impact.[10] First and foremost, excellent programs get at the heart of what it means to be tech savvy: program participants must use

### Solving problems with technology: STEMworks programs show the way

CompuGirls is an out-of-school program that empowers underrepresented teen-aged girls with the skill sets and dispositions they need to innovate with technology and address issues of social justice. Girls develop expertise in digital media, documentary filmmaking, podcasting, game design and creating virtual worlds with open simulation technology. For example, girls have created documentaries and digital games that bring public attention to important issues in their own communities, such as childhood obesity in poor communities and the disappearance of indigenous languages. CompuGirls has demonstrated that it raises participants' confidence in their ability to improve their communities using technology.

Girlstart provides year-round, intensive STEM education programs for K–12 girls, including after-school, summer camp, and community programs. For a holiday display in Austin, Texas, Girlstart girls generated 32,000 lines of code to operate the lighting patterns of a giant tree. Eighty-seven percent of participants in a Girlstart IT program enrolled in four-year college, and 80 percent of those students pursued STEM majors.

The National Academy Foundation, a network of high school career academies serving mostly low-income students, uses projects and work-based learning experiences to hone students' abilities to use technology in problem solving, analysis and classroom work. For example, students at one academy used digital technologies to design and build a solar-powered wind turbine that brought power to a small village in Nepal for the first time, providing electricity and heat to a school and birthing center. The academies boast a 97 percent high school graduation rate.

The Power of Data Project prepares teams of high school math, science, and career and technical teachers to help their students analyze data and solve problems using geospatial technologies. For example, students at one high school mapped and analyzed energy use in their school district, designed a database and mobile app to help district staff control their water and electrical use, and reduced the district's energy consumption by 14 percent. Research shows that teachers and students who participate in Power of Data improve their knowledge of science, spatial skills, and ability to solve problems using the scientific method.

Project Lead the Way is a curriculum and teacher professional development program that engages K–12 students in designing solutions for real-world global challenges. Students in Miami tackled the challenge of clean water by using technology to collect and analyze data, simulate and test potential solutions, and invent a Liquid Treatment System. That system is now used in Argentina, Haiti, Kasai (the Congo) and the Philippines. High school students who take Project Lead the Way classes are between three and four times more likely to pursue engineering in college.

Techbridge afterschool and summer programs introduce girls in grades 5–12 to new technologies and engage them in real-world design challenges. For example, one team of high school girls is using an open-source computing platform and a software development environment to design, prototype and test a bracelet that senses nearby objects and emits different tones depending on those objects' distance. This bracelet will help the visually-impaired get around. Techbridge alumnae are twice as likely as their peers to pursue STEM degrees in college.

technology to solve real-world problems. Young people who participate in STEMworks programs are using cutting-edge digital, communications, and geospatial technologies to address daunting environmental, medical, and social challenges. (See sidebar on previous page.) These programs offer a model schools and out-of-school programs across the country should emulate.

**Share lessons from business.** Competitive businesses use technology to solve problems as a matter of course. They know what tech skills are in demand and can help make educational opportunities truly relevant to the modern workplace. For example, the National Academy Foundation collaborates with STEM professionals to develop relevant curricula, secure the right technology tools, and give students exposure to actual work environments through opportunities such as internships and job shadows.

**Target underserved populations.** It is hardly news that women and people of color are woefully underrepresented in technology fields. Even the best STEM programs may simply perpetuate today's gender and racial disparities if they don't tackle this issue head on. Programs such as Girlstart, CompuGirls, and Techbridge provide girls and young students of color a welcoming environment, connections with peers, and access to role models who actually look like them.

**Teach the teachers.** Schools should ensure that teachers know *more* than their students about solving problems with robust, cutting-edge technology. Sixty-two percent of teachers in a 2012 survey identified lack of comfort with technology as one of the biggest barriers to incorporating technology into their teaching.[11] Programs like the Power of Data Project start with teachers, helping them master technology as a problem-solving tool before helping them design and teach problem-based lessons for their students.

## All hands on deck

Programs like those in STEMworks are giving some fortunate children and teens an edge that will serve them well—but as a nation we are leaving the technology skills of almost everyone else to chance.

Opportunities to learn problem solving with technology must become the rule rather than the exception. Business leaders are doing their part to bring STEMworks programs to hundreds of thousands more young people nationwide in 2015, and CTEq is working with them to expand those numbers dramatically in the coming years. Now is the time for business to join forces with government, educators, and other STEM advocates to ensure that all young people in the U.S. have the opportunity to become tech savvy.

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1 Experian Marketing Services, *Millennials Come of Age,* results from the Fall 2013 Simmons Consumer Study and the Fall 2013 Simmons Connect Study, June 2014.

2 Madeline J. Goodman, Anita M. Sands, and Richard J. Coley, *America's Skills Challenge: Millennials and the Future* (Princeton, NJ: ETS, 2015).

3 Goodman, Sands, and Coley.

4 For examples of PIAAC tasks, see Organisation for Economic Cooperation and Development, *OECD Skills Outlook 2013: First Results from the Survey of Adult Skills,* 2013.

5 Former FCC Chairman Julius Genachowski has argued that "50 percent of today's jobs require some technology skills – and this percentage is expected to grow to 77 percent in the next decade." FCC chairman Genachowski, "Remarks on Broadband Adoption," Washington, DC, October 12, 2011.

6 According to a report by Burning Glass and Capital One, middle skill jobs that require technology grew 2.5 times faster between 2003 and 2013 than middle skill jobs that do not require digital skills. The report finds that almost 80 percent of middle skill jobs require digital skills. Middle skill jobs comprise almost 40 percent of all jobs. See Burning Glass and Capital One, *Crunched by the Numbers: The Digital Skills Gap in the Workforce,* March 2015.

7 American Association of Colleges and Universities, *Falling Short? College Learning and Career Success,* January 2015.

8 See, for example, the Federal Reserve Board of Atlanta, "The Economic Plight of Millennials," *Econ South,* January-April 2014.

9 A study in the Netherlands, whose populations outperformed U.S. populations in technical problem solving, puts the cost of digital illiteracy at 19 billion Euros each year. See *CTRL-Alt-Delete,* Universiteit Twente, 2012. Grovo, a U.S. training firm, estimates that digital illiteracy costs the U.S. economy more than one trillion dollars each year. See "How the digital skills gap is killing productivity and what you can do about it," 2015.

10 See, for example: Cathleen Norris and Elliot Soloway,"One-to-one computing has failed our expectations". *District Administration,* May 2010; Winnie Hu, "Seeing No Progress, Some Schools Drop Laptops." *The New York Times,* May 4 May 2007.

11 Bill & Melinda Gates Foundation, "Technology and Effective Teaching in the U.S.," February 2012. Cited by Briana Pressey, "Comparative Analysis of National Teacher Surveys," The Joan Ganz Cooney Center at Sesame Workshop, Fall 2013.

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**Change the Equation** is a nonprofit, nonpartisan, CEO-led initiative that is mobilizing the business community to improve the quality of science, technology, engineering, and mathematics learning in the United States. Since its launch in September 2010, CTEq has helped its members connect and align their philanthropic and advocacy efforts so that they add up to much more than the sum of their parts.

CTEq's coalition of members strives to sustain a national movement to improve PreK-12 STEM learning by leveraging and expanding its work focusing on three goals: improving philanthropy, inspiring youth, and advocating for change.

**www.changetheequation.org**

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1101 K STREET, NW · SUITE 610 · WASHINGTON, DC 20005 · 202 626 5740