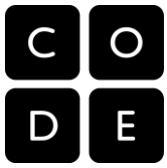

Testimony of
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Before the
US House of Representatives
Committee on Science, Space and Technology
Subcommittee on Research and Technology

STEM and Computer Science Education: Preparing the 21st Century Workforce
July 26, 2017

Chairwoman Comstock, Ranking Member Lipinski and Members of the Subcommittee, on behalf of Code.org, thank you for the opportunity to testify about the importance of computer science education in preparing the country's 21st Century Workforce. My name is Pat Yongpradit and I am the Chief Academic Officer of Code.org and a former computer science teacher.

Being a teacher is hard - being a computer science teacher is even harder. You are often the only computer science teacher in a school. If you are in one of the twenty-one states without a clear computer science certification pathway, you may have to be certified in a different subject to teach computer science. If you are in one of the 40 states that don't have computer science standards, you may lack any curricular direction and have to constantly craft resources on your own. Attendance at professional development or conferences? It probably comes out of pocket. In order to sustain your job, you may have to actively promote the program and recruit students. All of these applied to me. But Springbrook High School in Silver Spring, MD, had one thing going for it--at least it had a computer science teacher. As reported in a survey administered by Gallup, **the problem is that the majority of schools (60%) don't even offer computer science.**

The challenge before the nation is clear: Preparing enough teachers and creating policies that will install and sustain high quality computer science experiences for all students.

The STEM Crisis is a Computing Crisis

When we talk about the "STEM" crisis in our economy and schools, we are mainly talking about a computing crisis. The Bureau of Labor Statistics has projected that millions of new STEM jobs will be created between 2014 and 2024, and that the majority of STEM job growth will be in computing occupations. For comparison, 70% of new job growth in STEM fields will be in computing occupations,

while only 6% will be in life sciences. In fact, there will be more new job growth in computing occupations than all other STEM fields combined. The issue is that there aren't enough American graduates to fill the need, as only 8% of all STEM graduates are in computer science. This problem affects more than just the high tech field and traditional STEM areas. A recent report from Change the Equation uncovered that almost half of the 7.7 million professionals who use advanced computing skills, such as coding, are in non-STEM fields. Almost every job -- medicine, law, business, banking and even government -- increasingly requires foundational familiarity with computer science. A 21st-century doctor, lawyer, or banker may not need to know how to write complex code, but they at least need to understand the inner workings of an app, a website, cookies, software security, and other computing basics.

National numbers tell the big story, but state level data shows the local crisis. In Mrs. Comstock's state of Virginia, there are 35,591 open computing jobs (4.5x the state average demand rate) but only 1,570 computer science graduates. Of the 2,856 students who took the Advanced Placement Computer Science A exam in Virginia last year, only 24% were female. In Mr. Lipinski's state of Illinois, there are 21,204 open computing jobs (3.8x the state average demand rate) and 1,768 computer science graduates. Of the 2,938 students who took the Advanced Placement Computer Science A exam in Illinois last year, only 21% were female. Nationally, the AP Computer Science A exam boasts the lowest percentage of women text-takers among all 38 AP exams. Our states aren't graduating enough students in this field and even when there are interested students, they do not represent the broader population.

The key issue here is a matter of access, rather than demand. In a survey of what subjects students like the most, computer science outranked the core subjects and was only second to the arts and performing arts. 90% of parents want their children to learn computer science, but only 40% of schools offer it.

Computer Science Education and Code.org

I know that you and your colleagues on the Science, Space and Technology Committee and in Congress have grown increasingly aware of the importance of computer science education in K-12 schools in recent years. In fact, you and your colleagues have supported pieces of legislation that have been enacted and that have produced real results in growing access to computer science in the country's schools. For example, the passage of The STEM Education Act of 2015, which added computer science specifically to the definition of STEM at federal research agencies, inspired higher education institutions in Maryland to add computer science to their STEM endorsement programs for teachers. In addition, computer science is included as part of a "well-rounded education" in the 2015 revision of the Elementary and Secondary Education Act, and computer science teachers are specifically eligible for some of the professional development programs in the law. Thank you. At Code.org, we appreciate that progress and look forward to building upon it.

Code.org is a national nonprofit dedicated to expanding access to computer science in K-12 education—especially for female students and underrepresented minority students. We were founded in 2013 and are known best for our annual Hour of Code, which encourages people all over the planet to spend just

one hour learning a few fundamentals of coding. The event reaches tens of millions in over 180 countries each year--and even a few Members of Congress have tried it. But the Hour of Code is just the beginning—only a taste of what computer science has to offer. And it's only one small part of a larger effort to expand access to essential skills that put more students on the pathway toward career-readiness.

In addition to Hour of Code, we create open-sourced courses for students and adults. We offer professional development to prepare teachers to teach computer science at all grade levels. To date, we've prepared more than 60,000 teachers to teach computer science at all grade levels. We've also partnered with more than 120 of the largest school districts to add computer science to the curriculum. These districts teach almost 10% of all U.S. students and 15% of Hispanic and African American students. We are also building capacity in local organizations through a nationwide network of 41 regional partners. We are working hard to bring about wholesale change in the K-12 education system and have so many wonderful partners in this effort.

Along with our partners in the Code.org Advocacy Coalition, Code.org engages with state boards of education, state departments of education, governors' offices, and legislators. Code.org has been involved in the adoption of policies that support computer science in more than 20 states over the last few years. Nine governors have joined the Governors' Partnership for K-12 Computer Science, with Maryland's Governor Hogan announcing his membership on July 14, 2017. To guide states and school districts, Code.org partnered with four other organizations to steer the development of the K-12 Computer Science Framework. The Framework provides guidance to states and districts around topics such as curriculum, course pathways, teacher preparation, and standards.

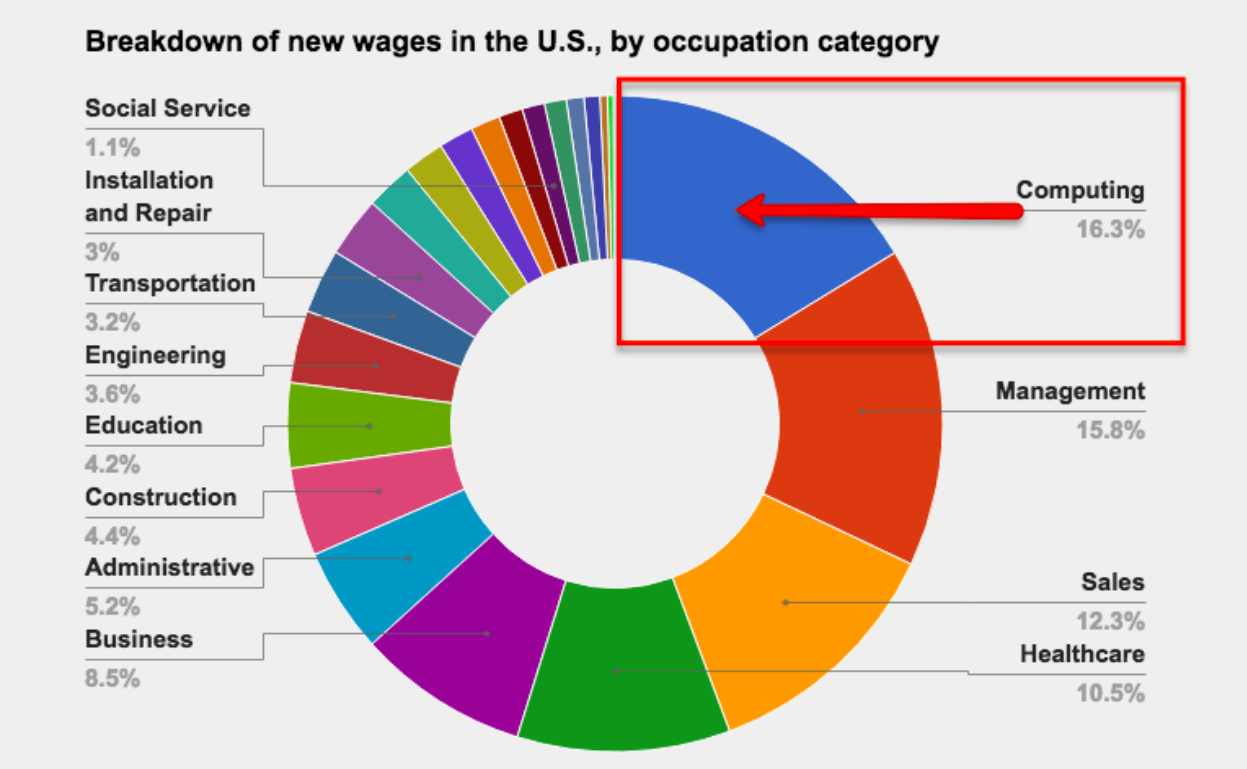
There has been much progress in growing access to K-12 education. In fact, this year, the broader computer science community celebrated a major milestone. In May, more than 50,000 students took a new Advanced Placement (AP) Computer Science course called AP Computer Science Principles, the largest launch for any AP course ever. Then, just recently, we learned that more than 29,700 female students took an AP computer science exam in 2017. That's a 135% increase from 2016 and a dramatic increase from the 2,600 female students that took the AP Computer Science exam 10 years ago. Furthermore, participation by black and Latino students increased by 170% since 2016, to more than 22,000. There are many factors that contributed to these gains, but we are encouraged by them and proud of the role we played in getting the nation to this point.

Looking forward, there is still much work to do. As I noted before, the majority of schools in the US still don't teach computer science at a time when more countries are choosing to require that computer science be taught to their students in elementary and secondary schooling. And, while 40% of schools do offer some amount of computer science, there is a challenge in expanding that to 100% rapidly since there are not enough computer science teachers right now to do so. Code.org and the computer science community continue to think about and address these issues daily. We are grateful for the help we have in that endeavor here on Capitol Hill, in the states and in local districts.

Growing Opportunities for Americans

Our working class – young and old, rural and urban, Democrat and Republican – is worried about being left behind by globalization, technological change, and a system that doesn't seem to reward hard work the way it used to. The American Dream feels broken.

Computing jobs provide individuals the most economic opportunity, and there are more than 500,000 open jobs in computing right now. This decade, computing occupations have become the single largest sector of *new* wages in the U.S. This isn't just about future jobs. It's about more than 500,000 currently open jobs. These are among the best-paying jobs in the country; they are private sector and public sector jobs. They support the country's security and is financial markets. And these job openings are growing almost twice as fast as all the other jobs in the country.



As you know, often our solution to fill these openings is to import talent from across the globe. Given the majority of high-skilled immigration is for computer scientists, we should embrace policies that will grow talent at home.

The opportunity goes far beyond just coding and California; this isn't just about Silicon Valley. 91% of open software and computing jobs are outside Silicon Valley. For example, in Michigan there are 14,384 *currently open* jobs.[1] This isn't just about tech companies. 67% of computing jobs are in retail, banking, transportation, entertainment, agriculture, manufacturing, and government.

[1] Data on current job openings in computer science: Conference Board data compiled by Code.org

The Solution is in Education and Re-training

Every school should offer computer science. Here are three specific things the Federal government can do:

1. **Provide federal funding for K-12 schools to teach computer science.**
   Every school should teach computer science. As a nonprofit that has been addressing this problem at a national scale our analysis shows the true cost is closer to $400M, as a one-time expense that could be spread over four years.

2. **Provide incentives to universities to prepare graduates for our workforce needs.**
   As tuition and student debt skyrocket, consider rewarding colleges that adapt their curriculum and teaching capacity to fit today's workplace needs. A computer science degree, from any college, is worth much more than any other college degree[2]. Students with these degrees are able to repay their tuition loans faster, and rarely default. Consider slashing their interest rates.

3. **Expand re-training programs for adults.**
   Create programs to retrain adults in computing skills to put the underemployed back to work. Technology boot-camps for adults are already the fastest-growing sector of private education, and they're needed in more regions, urban and rural.

Exposure in K-12 Addresses Cyber Issues

Given a growing cyber threat and our country's lack of preparation to defend itself, this issue goes beyond education and economic opportunity – it is a matter of *national security*, evidenced by the Department of Defense's own challenges in hiring software and cybersecurity experts. The weakest link in our cyber defense is our own citizens and their inadequate technology education.

Cybersecurity cuts across many domains of study, but the technology itself has its roots in computer science. Because of the unique role cybersecurity specialists play in our country's security, the most sensitive jobs in this field must be filled by US citizens. And it's clear we are not producing enough highly skilled security specialists to address our growing cybersecurity needs. A report from the Center for Strategic and International Studies stated, "There are only about 1,000 security specialists in the United States who have the specialized skills to operate effectively in cyberspace; however, the United States needs about 10,000 to 30,000 such individuals."[3]

Expanding access to K-12 computer science will help meet the specialized needs of the cybersecurity workforce needs in the long run. As our overall pipeline of diverse students in the US interested in and willing to study computer science in higher education expands, so will the potential pool of students specializing in the technical aspects of cybersecurity.

Beyond just giving students access to the foundational aspects of computer science, we can also expose students to specific cybersecurity concepts within K-12. For example, students can understand how

[2] Comparison of the lifetime value of college degrees: the Hamilton Project.

[3] http://csis.org/publication/prepublication-a-human-capital-crisis-in-cybersecurity

technology impacts their lives (e.g., social networking, cyber-bullying, mobile computing). In a high school introductory course, all students can develop a broad understanding of computer science that exposes them to basic principles of security such as cryptography, threats, and authentication, which will increase interest in taking more specialized courses in cybersecurity. Cybersecurity education has a natural home within computer science courses, and as these courses expand in K-12, we can also expand exposure to and the depth of cybersecurity-specific instruction.

Policy and Expanding K-12 Computer Science Access

Decisions about education funding, standards, and policies are often local ones. But we've never had an urgent need to add an entire new field of study to our K-12 system. The Reagan Administration first sounded the alarm for teaching computer science in high school. 30 years later, less than half of our schools even offer it, we struggle to fill open computing jobs, and our national security is at risk. U.S. governors -- all of whom support more local control of education -- recognize this issue goes beyond any one state. Last year, 27 bipartisan Governors came together to ask Congress for targeted funding to address this issue.

History has shown local programs alone won't address this problem. How many state departments of education have even a *single* employee in charge of K-12 computer science? Only eight. If there's not even a single person running a computer science department at the state or district level, the local budget will be divided among the departments that already exist, leaving nothing for the computer science department that hasn't even been formed yet.

Everybody agrees we should do this. Support for computer science is gratifyingly strong. It has the bipartisan support of Governors, Members of Congress, and Mayors from both sides of the aisle. Surveys show that 90% of American parents want their children to study computer science in school, and 88% want this to have federally funding support. Last year, a coalition of Fortune 500 CEOs, governors, educators, and nonprofit leaders signed an open letter asking the Federal government to fund computer science education. This issue has the support of not just every major *tech* CEO, but also the CEOs of America's top airlines, hotel chains, banks, manufacturers, entertainment companies, you name it.

Conclusion

Despite the divisions in America, we can find common ground on issues like this, that everybody agrees on. I am proud of Code.org and its allies in the computer science community that have made so much progress in recent years. I look forward to building on it.

Thank you again and I'm happy to answer any questions you have.

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