

US House of Representatives
Hearing: Private Sector Programs that Engage Students in STEM
Committee on Science, Space and Technology
Subcommittee on Research and Technology

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Chairman Bucshon, Ranking Member Lipinski, on behalf of Code.org and its advocacy arm -- Computing in the Core -- thank you for the opportunity to testify about our goal of giving *every* student in the United States access to computer science as part of their K-12 educational experiences. I also want to thank you for being cosponsors of the Computer Science Education Act (H.R. 2536) -- common-sense, bipartisan legislation that will improve computer science education.

I am Hadi Partovi, and I've spent most of my career as an entrepreneur and investor in technology. But before that I was lucky enough to be exposed to computer science early on. When I moved from post-revolutionary Iran to the United States as a teenager, it was my foundation in computer science that gave me the opportunity to study and teach the subject at Harvard University, begin my career at Microsoft in the 1990s, and then move on to found numerous successful startups. My background in computer science helped me become an early-stage investor or advisor to leading technology companies, including Facebook, Dropbox, airbnb, OPOWER, Bluekai, and others.

Introduction

Last month, over 17 million students across the United States participated in our "Hour of Code" campaign, giving them their first taste of computer science. This stunning result shows students clearly want to learn computer science, and we know that there is strong demand for these skills in the workplace.

When we talk about the "STEM" crisis in our economy and schools, we are really talking about a computing crisis. In fact, according the Conference Board, demand for computing professionals is roughly four times higher than the average demand for all other occupations, with more than 580,000 jobs in computing open as of December 2013.¹ (For state-specific data from Subcommittee Members' home states, see Appendix 1.) Furthermore, more than half of all jobs in STEM fields will be in computing.² These are generally understood facts, but what is less well known is that almost every job --

¹ Source -- US Conference Board Help Wanted Online Service

² Source -- Code.org analysis of BLS 2010-2020 employment projections (we have not yet analyzed the BLS 2012-2022 projections released at the end of December).

medicine, law, business, and banking -- 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 increasingly need to understand the inner workings of an app, a website, cookies, software security, and other technology basics.

Despite these facts, most K-12 schools do not offer computer science, and students are not expected to be exposed to it at any level. In fact, last year, only 1 percent of Advanced Placement (AP) students studied in computer science. And only a tiny fraction of that 1 percent are women and underrepresented minorities.³ Computer science is simply not part of what we call the “core” curriculum in our schools. It is an afterthought. As a result, cohort after cohort of students are being denied the knowledge and skills they need in our increasingly digital world. Our K-12 schools teach students how to dissect a frog, or how electricity works -- it’s time they also taught how to “dissect an app”, or how the Internet works.

It’s not easy to add a new, rapidly-evolving field to the K-12 curriculum, but it’s a challenge our schools must meet. The UK has already put in place a plan to bring computer science to every school, nationwide, starting in September. But in the US, when we talk about STEM, when STEM policies are translated to action, “STEM” is translated to mean the same fields we’ve taught for decades: biology, chemistry, physics, and calculus. These are important, foundational topics. But we need to focus the STEM conversation on a new field, a field that is driving 50% of new STEM jobs, a field that is increasingly foundational across all careers in science, business, government and law, a field that is not being taught in the majority of our schools. Today when we say “STEM”, computer science is ignored. We need to change that conversation.

This committee has heard many times from organizations and leaders within the computing community about the challenges and need to improve K-12 computer science education. I want to echo those remarks and build on them by describing how Code.org is bringing community and corporate leaders together to give students access to computer science education.

Introducing Code.org

Code.org is a non-profit dedicated to expanding participation in computer science education by making it available in more schools, and increasing participation by women and underrepresented students of color. Our vision is that every student in every school has the opportunity to learn computer programming.

I started Code.org in 2012 as a personal mission with my twin brother, Ali Partovi, setting out to make a video that would inspire students to take interest in computer science. That video “What Most Schools Don’t Teach”, starring Bill Gates, Mark Zuckerberg, and other tech heroes and celebrities struck a chord with Americans. Within one week it reached 10 million views and 10,000

³ Source: College Board

school districts contacted Code.org asking how they could get coding into schools. At the same time, a partnership of the Association for Computing Machinery, the National Science Foundation, the Computer Science Teachers Association (CSTA), the National Center for Women and Information Technology, Microsoft and Google joined with Code.org in a new strategy that leverages our consumer awareness while building off years of efforts by the computing community to bring computer science into schools.

The Hour of Code

In the last few years, I often thought about how impactful it could be to introduce every American student to computer science for just one hour. Everywhere I went, I heard people express how important computer programming skills are for today's generation of students, so when Code.org grew into a staffed organization only months ago, we decided to immediately challenge Americans to get behind this cause.

The Hour of Code campaign aimed to demystify computer science, to encourage students to try it for just one hour through online tutorials hosted by Code.org and others. Code.org itself developed an introductory computer science activity -- in collaboration with engineers from Google, Microsoft, Facebook, and Twitter -- that plays like a game, featuring video lectures by technology-industry leaders like Mark Zuckerberg and Bill Gates and artwork from popular online games, like PopCap Games' Plants vs. Zombies and Rovio's Angry Birds. We worked with other education organizations such as the National Center for Women and Information Technology, the Computer Science Teachers Association, the National Science Teachers Association, the National Council of Teachers of Mathematics and Khan Academy to help create the experience or distribute it to our public schools. We encouraged K-12 teachers, principals and districts to sign up their schools to participate during Computer Science Education Week in December, as well as after-school programs, parents, and individuals.

When Code.org announced the Hour of Code in October, the goal to teach 10 million students for 1 hour was an ambitious one. The vision proved to be an enormous success. Last month, 20 million students participated in computer science, including 1 in 4 students in kindergarten through 12th grade in the US. Perhaps even more astonishing was that half of these students were girls. As you can imagine, Code.org relies on statistics and analytics to measure progress, and the results of just this one week blew us away. In U.S. schools, more students participated in computer science during Computer Science Education Week 2013 than had ever taken computer science in the history of our K-12 system.

The results were widely covered by media. There were pieces in the *New York Times*, *Washington Post*, *Los Angeles Times*, *Miami Herald*, *Chicago-Sun Times*, *TIME*, *US News and World Report*, *Politico*, *Wall Street Journal*, *Forbes* and on Bloomberg Television and CNN. It was featured on the homepages of Google, Microsoft, Bing and Yahoo!. Every Apple retail store in the United States hosted an Hour of Code workshop. Stop and consider that these technology giants and fierce competitors were coming together for the first time in this common cause. In addition, the campaign was promoted broadly by the College

Board, Teach for America, NSTA, NCTM, CSTA, and state commissioners and superintendents of California, Hawaii, Washington, Massachusetts, and Tennessee.

Communities reported on local Hour of Code events everywhere from Louisville, KY, to Boise, ID, to Detroit, MI, to Houston, TX, to La Crosse, WI, to San Francisco, CA, to Harrisburg, PA, to hundreds more cities, towns and counties across America. In fact, in the Chairman and Ranking Member's states of Indiana and Illinois, more than 260,000 and 830,000 students⁴ participated in the Hour of Code. (See Appendix 1 for participation in each Subcommittee Member's state.)

What was even more stunning than the data on participation was the outpouring of support for the Hour of Code from educators. Too often our national narrative is how our schools, teachers and leaders are failing students. The Hour of Code story was much different. Teachers, principals and superintendents in every part of America took the initiative to bring this educational experience to their students. Over 12,000 U.S. schools signed up to host an Hour of Code event for the *entire* student body. We heard stories from teachers about students "working together for the first time to solve problems," or that they "didn't even know coding was something you could teach students", but that "it turned out to be one of the smoothest class periods we've ever had." Most importantly, teachers reported that students came back wanting more. In the past month, 10,000 teachers have signed up 500,000 students for our follow-on 20-hour, online Introduction to Computer Science course. This is a complete 20-hour curriculum that is in 10,000 classrooms today.

Parents also played a big part in the success of spreading this campaign. They have a deep sense of how important technology is today, but its creation is somewhat of a mystery. Every American feels that technology is moving so fast they can hardly keep up; technology is passing them by, and they don't want their children to fall behind too. The Hour of Code gave every parent the opportunity to open a window to the world of technology for their children and to better understand computer science themselves.

But one hour of code is only a first step. We have given 1 in 4 students in the U.S. a taste of computer science. But it raises the question: why isn't this a fixed part of our school system? Now local, state and national leaders need to come together to bring computer science into the core of our education system. Code.org, in collaboration with its partners both within and outside of the computing community, hope to work with our national leaders on this mission.

Bringing Computer Science to ALL Students

Code.org believes computer science should be part of the core curriculum in education, starting as early as elementary school. Our goals include: (1) Bringing Computer Science classes to every K-12 school in the United States, especially in urban and rural neighborhoods, (2) Demonstrating the

⁴ Based on Code.org analysis of Google analytics and geolocation data from Computer Science Education Week. Due to constraints on this analysis, there is a +/- 10% margin of error in the numbers.

successful use of online curriculum in public school classrooms, (3) Changing policies at the federal and state level to either remove barriers to K-12 computer science education or bolster its instruction, (4) Harnessing the collective power of the tech community to celebrate and grow computer science education worldwide, and, (5) Increasing the representation of women and students of color in the field of computer science.

Code.org's Programs

Our mission is carried out via three program pillars: educate, celebrate and advocate.

Educate

Our education pillar aims to create modern, engaging computer science curriculum for all levels of K-12 students and to partner with school districts to deliver instruction. We are bringing two high school computer science courses to scale -- Exploring Computer Science and AP Computer Science Principles:

- Exploring Computer Science⁵ is a nationally recognized introductory college preparatory computer science course and includes curriculum, professional development, and assessments. ECS is composed of six foundational units with lessons that are designed to promote an inquiry-based approach to teaching and learning foundational concepts in computer science and highlighting the computational practices and problem solving associated with doing computer science.
- Computer Science Principles⁶ is currently in a pilot phase that will inform the ultimate development of an AP[®] exam in 2016-2017; this course is far more than a traditional introduction to programming and the fundamental concepts of computing. It is a rigorous, engaging, and approachable course designed so that each student will understand how these concepts are transforming the world we live in and how each student can use the concepts in their own lives, studies, and in collaborating to participate in the transformation.

Both of these courses are designed to broaden participation in secondary computer science and prepare students for post-secondary experiences related to computing or college majors in computer science. They are supported by top experts within the computer science education community and have been developed with the support of the National Science Foundation and others, such as the College Board and the Computer Science Teachers Association. In addition, we are offering districts an Elementary Computer Science Program and a Middle School Computer Science Program, which consist of interdisciplinary modules that combine computer science concepts with Science and Math.

⁵ see, <http://www.exploringcs.org/>

⁶ see, <http://www.csprinciples.org/>

Our district partnerships encompass curriculum for elementary, middle and high schools and professional development for teachers. More information on our partnership program, including how you can help us bring computer science to the schools you represent, can be found at: <http://code.org/educate/districts>.

During Computer Science Education Week, we announced two of the largest of our partnerships -- agreements with Chicago and New York City. A particularly exciting element of the Chicago plan is a commitment to expanding computer science instruction to all students and making it a required course for all students within 5 years.

Celebrate

Our celebrate pillar works to neutralize negative stereotypes of the field, inform students of the benefits of studying computer science, and inspire them to do so. The focus of this area has been the Hour of Code effort noted in the previous section and our original video “What Most Schools Don’t Teach.” Today, the stereotype is that computer science is for genius nerds, often portrayed in the media as Asian or white teenage boys. Thanks to the Hour of Code campaign, 10 million girls learned an Hour of Code last month. We hope our continued efforts will break the stereotype permanently.

Advocate

Our advocacy pillar works on policy issues at the federal and state level, through our sister effort Computing in the Core. More detail on proposed federal policy reforms and recommendations are noted below. Our main goal is either removing barriers that hinder computer science instruction or passing policies that will bolster its instruction.

At the state level, our headline goal has been to “make computer science count,” which means allowing existing courses to satisfy an existing core math or science graduation requirement. Making computer science courses “count” would not *require* schools to offer computer science or students to study it; it would simply *allow* existing computer science courses to satisfy a requirement that already exists. Only 17 states allow computer science to satisfy a core high school graduation requirement at present.

Computer science courses often do not count towards a student’s required coursework – they are treated as electives. Given the academic demands, college-bound students cannot afford to take computer science as an elective. AP Computer Science courses are about 50 percent larger in states that “count” AP CS compared to those that do not.⁷ And a study from the Computer Science Teachers Association shows a key driver for whether underrepresented groups (females and students of color) participate in computing courses is whether the CS course they are taking counts toward a graduation credit.⁸ This policy also helps student athletes, as the NCAA recently changed eligibility requirements to

⁷ Code.org analysis of College Board AP data

⁸ CSTA/My College Options, Annual Research Report 2013

allow rigorous computer science courses which count towards a mathematics or science credit in a school district to automatically meet NCAA student-athlete entrance requirements.

I should note that the Chairman's home state of Indiana is one that allows a rigorous computer science course to satisfy a "core" high school graduation credit. In fact, it made this change after local advocates brought the issues discussed in this testimony to Indiana state education leaders.

The support for this policy change is both bipartisan and growing. In 2013 six states -- Maryland, Idaho, Alabama, Wisconsin, Tennessee and Washington -- with both Republican and Democrat controlled leadership "flipped" from treating computer science as an elective to allowing it to count toward a mathematics and/or science course.

We are now increasingly beginning to look toward states where statewide policies and programs can support the expansion of computer science in K-12 schools. State education authorities should be planning their computer science offerings across the state just as they do other core academic offerings. We will be working with states to put new policies in place to make statewide computer science adoption a reality.

Partnerships

The successes of Code.org in large part are due to a unique combination of both private and public partnerships. Code.org supporters include dozens of the best-known tech companies and their founders, as well as the Computer Science Teachers Association, the Association for Computing Machinery and the National Science Foundation.

The Hour of Code campaign is an example of Code.org's ability to leverage a diverse partner network to execute a national awareness campaign. National student and teacher facing nonprofits like the Boys and Girls Club of America, The College Board, Teach for America, and NSTA were integral in mobilizing large networks of both in- and after-school participation. Similarly, large companies like J.P. Morgan and Zappos urged employees and local schools to participate, as well as hosted events at their headquarters for outside community members to join.

Additionally, the campaign had the backing of the computer science education community at large. We recruited other tutorial providers (both non and for-profit groups) such as Khan Academy, Codecademy, Scratch, and Tynker to showcase and promote their computer science curriculum through the Hour of Code campaign. This was beneficial in two ways: 1) it created additional promotional networks, and 2) it accounted for the fact that there is no one-size fits all curriculum.

Moving forward, Code.org hopes to expand and formalize current partnerships as well as establish new ones to build on our education and advocacy goals. Code.org isn't the only organization in this space, but we have established an unprecedented scale in computer science education by partnering with leading organizations and individuals from the tech industry, education non-profits, and government.

We don't expect to do everything ourselves; we expect to provide an overall umbrella for dozens of organizations (public or private) to collectively bring computer science to the nation's schools. Our founding roots come from warring tech companies (Microsoft, Google), education non-profits (ACM, NCWIT, CSTA), and government (NSF), and as such we expect to unite these three types of organizations in a public-private partnership until the national opportunity has been captured.

Federal Policy Reform to Strengthen Computer Science Education

When I started to educate myself on the reasons computer science isn't taught in our schools, I found what you all know--there are countless federal, state and local policies that determine what is ultimately taught in our schools. I have learned much about the No Child Left Behind Act, the Higher Education Act, Career and Technical Education programs, the Labor Department's workforce supports, the National Science Foundation's investments, America COMPETEs, Race to the Top, public investments in afterschool programs and other federal initiatives, policies and investments. Knowing that the goal of our public education system is to prepare our young people for success in college and/or the workforce, it is confounding to me that most schools don't even teach computer science. In the 21st Century, this has to change.

Computer science is not treated as a "core academic subject" in the Elementary and Secondary Education Act. It is not an element of the accountability rubric states put together as part of the improvement plans required by the federal government in return for Title I funds. Computer science teachers are not eligible for the same professional development supports as their math and science teacher colleagues. Getting certified to teach computer science is an ambiguous and confusing process in most states, and almost impossible in a few. A few changes to existing programs could make it much easier to give students the opportunity to learn computer science.

I am thankful that both the Chairman and Ranking Member and other members of this committee have supported modest, no-cost changes to the Elementary and Secondary Education Act that are proposed in the Computer Science Education Act (H.R. 2536) by cosponsoring the bill. And while they aren't members of this panel, I'd like to also thank Congresswoman Susan Brooks (R-IN) and Congressman Jared Polis (D-CO) for their leadership and vision in sponsoring this legislation and raising the issue of K-12 computer science education before Congress. Senators Bob Casey (D-PA) and Marco Rubio (R-FL) have introduced similar legislation (S. 1407) in the Senate, making the issue both bipartisan and bicameral.

The Computer Science Education Act makes simple changes to federal law to ensure computer science is at the table when local education decisions are being made. It is an important first step Congress can immediately take to improve student access to K-12 computer science education, and will empower local educational agencies to meet the enormous demand for computer science that the Hour of Code has uncovered. I hope more Members will sign on to the bill and ask leadership to consider it before the end of the 113th Congress.

More directly related to the purview of this Committee, I urge you to ensure that computer science is explicitly included as a focus of public investments and policy goals. Even the definition of “STEM” in existing statutes marginalizes public investments in computer science. “Science, technology, engineering and mathematics” doesn’t explicitly include computer science, which is problematic in the regulatory process at certain agencies and in the award process at others. I hope that revisions to any laws that include a definition of STEM will explicitly include computer science. When it is not explicitly included, it is quite often implicitly excluded, because it is easier for school systems to focus only on the topics they already teach, such as biology, chemistry, physics, or calculus.

There is some good news on this front. Recently, the National Science Foundation revised some of its education programs. The result is a new STEM-C program that will preserve the Math Science Partnerships program, and create a new emphasis on investments that focus on the improved teaching of computer science. We hope that other programs and agencies follow this lead and look forward to collaborating with the Foundation and its grantees to bring more and better computer science to our country’s schools.

The palpable interest in giving the country’s young people access to computer science has buoyed the policy efforts of Code.org, Computing in the Core and the members and supporters of both organizations. We will work on a number of policies to broaden access to computer science. For example, in America COMPETEs, we will work to make sure that computer science teachers--prospective and practicing--are supported in the same way that math and science teachers are. In addition, we are hopeful that the National Science Foundation can help the field develop standards-based assessments for K-12 computer science. Congress will soon debate reauthorizing the Higher Education Act, and that statute addresses federal investments in teacher preparation programs. As you can imagine, there are few colleges that offer teacher education programs for computer science teachers. Changes to the Higher Education Act would catalyze reform in this area. Cybersecurity legislation, federal investments in research, efforts to nurture interest and success in the STEM fields, comprehensive immigration reform efforts that tie H-1B visa fees to a new STEM education fund and revisions to the E-Rate program are among the policies that we feel can be changed to support the teaching and learning of more computer science in K-12 schools. We hope you can be allies in our endeavors on Capitol Hill.

Conclusion

While I am encouraged by the response to the Hour of Code and Code.org to date, I know that much work lies ahead. We are building on years of work from so many people and organizations committed to the cause of expanding access to computer science, and we’re busily developing curriculum and recruiting professional development facilitators to get high-quality computer science courses in as many schools as possible--as soon as possible. As I said earlier, I have learned that changing education requires working with stakeholders of every size and policymakers of every disposition at the local, state and federal levels. As a result, Code.org and our partners are collaborating with districts on agreements related to teacher supports and classroom resources; we are working to get computer science to count as a high school graduation credit in as many states as possible; and, we are sharing our arguments with

you and your colleagues for changes to federal programs and policies that currently don't respect the importance of computer science in the educational landscape.

The modern day icons of the American Dream have gotten where they are through computer science. I truly believe that the availability of computer science to all kids is an issue that warrants immediate and aggressive action. And, thankfully, I'm not alone.

While the tech industry is known for many things, agreeing among themselves on big issues is not one of them. Except for this one. Apple, Google, Microsoft, Facebook, Amazon, SAS and so many others compete vigorously for talent, ideas and market share, and yet they have come together to support broadening access to computer science education. I'm proud of my colleagues and humbled by their trust on this important issue and hope that the tremendous success of the Hour of Code is only a sign of good things ahead.

With 17 million US students participating in the Hour of Code in December, I claim that our students have voted with their actions: that learning computer science is this generation's Sputnik moment, that it's part of the new American Dream, and that it should be available to every student, in every school, as part of the official curriculum.

I look forward to answering any questions you might have, and thank you again for the opportunity to testify today.

More information about Code.org, Computing in the Core and our partners, the Hour of Code tutorial, the inspirational videos that highlight the need for more computer science and the work of our talented team of engineers and education professionals is available on our website at www.code.org.

Appendix 1. Computer Science Data for Subcommittee Member States

Information on computing jobs, computer science graduates, the number of schools that teach rigorous computer science and Hour of Code participation in the states represented by Members of the Subcommittee on Research and Technology.

Alabama State Facts

- **3,541** open computing jobs
- (growing at **3.4x** the state average)
- **541** computer science graduates
- **26** schools teach computer science
- **187,000** students did the Hour of Code in Dec 2013

Arizona State Facts

- **9,913** open computing jobs
- (growing at **3.5x** the state average)
- **336** computer science graduates
- **33** schools teach computer science
- **300,000** students did the Hour of Code in Dec 2013

California State Facts

- **77,309** open computing jobs
- (growing at **4.3x** the state average)
- **4,324** computer science graduates
- **311** schools teach computer science
- **3,000,000** students did the Hour of Code in Dec 2013

Connecticut State Facts

- **7,926** open computing jobs
- (growing at **4.5x** the state average)
- **389** computer science graduates
- **65** schools teach computer science
- **180,000** students did the Hour of Code in Dec 2013

Florida State Facts

- **20,384** open computing jobs
- (growing at **3.6x** the state average)
- **1,833** computer science graduates
- **125** schools teach computer science
- **1,150,000** students did the Hour of Code in Dec 2013

Illinois State Facts

- **25,691** open computing jobs
- (growing at **5.1x** the state average)
- **2,691** computer science graduates
- **132** schools teach computer science
- **830,000** students did the Hour of Code in Dec 2013

Indiana State Facts

- **4,864** open computing jobs
- (growing at **3.5x** the state average)
- **1,152** computer science graduates
- **54** schools teach computer science
- **264,000** students did the Hour of Code in Dec 2013

Kentucky State Facts

- **3,411** open computing jobs
- (growing at **4.4x** the state average)
- **295** computer science graduates
- **34** schools teach computer science
- **144,000** students did the Hour of Code in Dec 2013

Mississippi State Facts

- **951** open computing jobs
- (growing at **4.3x** the state average)
- **203** computer science graduates
- **14** schools teach computer science
- **53,500** students did the Hour of Code in Dec 2013

New York State Facts

- **36,824** open computing jobs
- (growing at **4.9x** the state average)
- **5,037** computer science graduates
- **186** schools teach computer science
- **780,000** students did the Hour of Code in Dec 2013

Oklahoma State Facts

- **3,226** open computing jobs
- (growing at **3.6x** the state average)
- **416** computer science graduates
- **49** schools teach computer science
- **80,000** students did the Hour of Code in Dec 2013

Texas State Facts

- **42,016** open computing jobs
- (growing at **4.1x** the state average)
- **3,160** computer science graduates
- **376** schools teach computer science
- **910,000** students did the Hour of Code in Dec 2013

Washington State Facts

- **24,181** open computing jobs
- (growing at **3.9x** the state average)
- **794** computer science graduates
- **62** schools teach computer science
- **695,000** students did the Hour of Code in Dec 2013

Wyoming State Facts

- **304** open computing jobs
- (growing at **3.6x** the state average)
- **22** computer science graduates
- **3** schools teach computer science
- **40,000** students did the Hour of Code in Dec 2013

The data is based on information provided by The College Board, the Conference Board Help Wanted Online and other public resources. This information and other state-specific data are available on the Code.org website at www.code.org/promote/XX (XX is the two-letter state abbreviation).