**Results from the CSTA-Oracle Academy 2014 U.S. High School CS Survey:**
*The State of Computer Science in U.S. High Schools: an Administrator's Perspective*

As we usher in the New Year, we have much to celebrate: interest in computer science education has reached an unprecedented high. Last month, an estimated 80 million students, teachers, administrators, parents, and community members across the globe participated in Computer Science Education Week (CSEdWeek), an annual event committed to ramping up engagement in programming, app development and design, robotics, networking, and other computational thinking skills and activities. Yet despite the recent frenzy of activity surrounding computer science (CS) and its relevance among the constellation of core disciplines, there remains a notable lack of accurate and generally available information about the state of CS education in United States high schools.   Much of the existing research fails in multiple ways.  It fails to clarify the relevance of computer science education today and the importance of aligning it to core curriculum, and it fails to illuminate issues of access and the true state of computer science education in US high schools.

Interest in CS will continue to rise, and along with it a considerable need for data to help inform educators, policy makers and others about the efficacy of US computer science education. In this spirit, the Computer Science Teachers Association (CSTA), in collaboration with Oracle Academy, administered an online survey to over 20,000 Public and Private 9–12 secondary school Principals and Vice Principals in the United States between May and September of 2014. The purpose of the survey was to identify computer science education opportunities that are being provided at the high school level, determine how broadly CS is being offered in the US, and determine the different ways CS was being defined in the schools. Surveys were also sent to administrators across the United States using contact information provided by a market data company. A total of 503 people responded to the survey[1]. Schools from 47 states participated (no responses were received from Hawaii, Vermont, or Wyoming). Administrators from California submitted the most responses (35), followed by Pennsylvania (34), and New York (31). Most of the responding schools support between 250 and 2,000 students, as below.

**How would you describe your school?**



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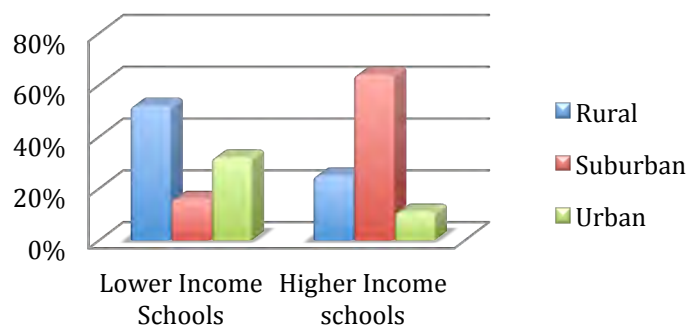
[1] According to Meeting Professionals International (MPI) and Raosoft, Inc., this is a statically representative sampling size.

**How many students attend your school?**
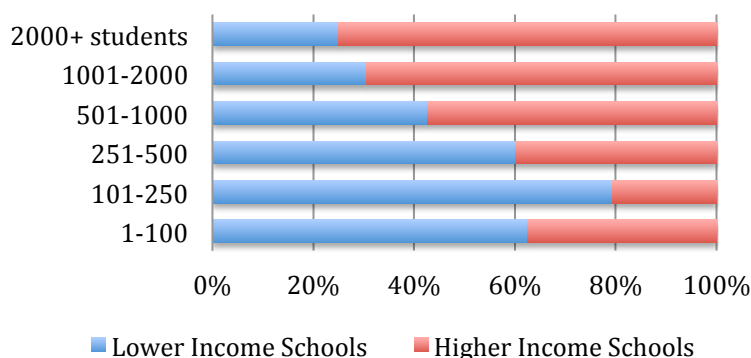


The survey results show that among the schools' academic departments, Career & Technology and Business emerged as those chiefly responsible for teaching computer science. Of the 73% of respondents whose schools offer computer science, an overwhelming majority counts these credits as requirements for graduation. However, only 39% of those schools count a CS class towards a requirement in math, science, or technology. This means that schools are more likely to count CS courses as electives. Where this becomes problematic for CS is that electives are often culturally and academically regarded as filler classes in a student's schedule. Student resources, such as College Board's BigFuture™, advise students to maintain course load balance by selecting easier electives: "Handling four or five core courses each semester doesn't leave a lot of room for extras. Some schools offer electives … that complement your extracurricular activities. Classes like these can reduce your after-school time commitment, giving you more time to study."[2]

The question of why students choose to fill their elective credits with fewer academically rigorous classes is likely answered by a combination of reasons. Chiefly, easier classes help to maintain course load balance, less demanding classes may secure or inflate GPA, and there appears to be a general cultural assumption that electives are primarily for fun. Classes that demand high degrees of problem solving, computational thinking, analysis, and mental rigor are associated with the core disciplines. Two possible approaches are to change the culture of how we regard electives, and/or designate CS as a core requirement. Yet, if we do nothing, we will continue to graduate students who are unequipped to navigate the demands of a 21st century workplace.

Administrators were asked specifically about the content covered in core academic computer science classes as opposed to career technical education (CTE) courses. To these questions, several participants submitted "other" responses such as "I don't know," "can't remember what was covered," "not sure," and "what is CTE?" This is important because frequently, CS courses are entered into CTE tracks for Perkins Funding, because they are classified as having a vocational slant, or because the skills acquired in computer science classes can prepare a student for postsecondary success without pursuing a college degree. From the data, we conclude that at school administrative levels, there is a potentially problematic lack of knowledge of the elements of curriculum being billed as "computer science."

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[2] "How to Choose High School Electives."

In addition, participants applied the term "computer science" to a vast array of topics and courses, many of which were submitted as "other" courses in response to the topics that were provided in the survey. Participants classified studies in business management, yearbook layout, artificial intelligence, robotics, office applications, and automated design as computer science courses. This broad use of "computer science" to encompass curriculum and courses that would not be considered "computer science" at a college/university or professional level indicates a need for educational community consensus on a common definition of computer science education[3] and curricular content, lest we lead students or teachers to believe they are preparing students for college and careers when in fact, they are not. This perhaps begs the question whether "computer science" as a designation is being applied inappropriately for funding or other reasons.

Administrators stated that the most prevalent computer science course offered was Web Design and Development, followed by Intro to Computer Science with 54% of the schools offering it in grade 9, 47% offering it in grade 10, 39% offering it in grade 11, 37% offering it in grade 12, and only 27% offering at least one intro to CS course all four years. These were followed by computer graphics and programming. The top four content areas covered in computer science courses were listed as problem solving at 65%, ethical and social issues and graphics tied at 57%, and web development at 51%. However, analysis of algorithms came in at 35% as did testing and debugging. Each of these content areas are core to computer science and in particular programming.

One of the most important findings from the study suggests that better-funded schools are offering CS to their students at a far higher rate than low-income schools. This research verifies what was only previously suspected. Of the 27% of schools where the majority of students qualify for free or reduced lunch, 63% offer computer science courses. Of the 44% of schools where the majority of students *do not* qualify for free lunch, 84% offer computer science courses.

For all schools surveyed, regardless of income status, data showed a strong correlation between those who teach computer science during the regular school day and those who offer after school programs in computer science:

- Of the lower income schools that don't offer computer science courses, fewer than 11% offer an after school program in computer science, compared to 40% of schools that teach computer science.
- Of the higher income schools, only 16% of schools not offering CS courses provided after school or extracurricular programs in computer science, whereas an overwhelming 99% offered an after school or extracurricular program in computer science if the school offered CS courses.

This means that in lower income schools, 37% percent offer no computer science whatsoever, versus only 16% percent in higher income schools. Developing a computer scientist requires a multi-year pathway to develop CS-related skills. The fact that students in lower income schools have little to no access to CS over the course of their high school careers puts them at a disadvantage for both future college and career

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[3] CSTA's definition of computer science may be found at www.csta.acm.org.

pursuits, and this has potential far-reaching social and economic consequences for broader American society.

The survey data illuminate several key conclusions:

- Despite recent attempts to educate the community and expose more students to CS, there is still a huge misunderstanding of what CS is and what it isn't. This is important because without consistency in class offerings and a common understanding of computer science in K–12, universities will continue to resist adding CS courses as accepted math or science credits for admission. Also, we will have fewer qualified educators teaching CS and students who enter college will be woefully behind compared to schools that do offer a true-to-the-definition and comprehensive CS curriculum.
- A related issue is that qualified CS teachers will not be hired to teach, a problem that is not likely to be alleviated without clear agreement about what is and is not a computer science course requiring a certified CS teacher. Computer Science teacher certification across the nation is typified by confounding processes and illogical procedures that keep it from functioning as intended. CSTA's report, *Bugs in the System: Computer Science Teacher Education in the U.S.* aims to determine the nature of Computer Science teacher certification in the U.S. and details the results for each state and the District of Columbia.
- Despite a concentrated effort by the CS community and its supporters, CS continues to remain an elective, and more schools do not count it towards a graduation requirement than do. This is important because without it counting, fewer resources and funding will be allocated to help implement CS programs. It is also important because electives don't count toward college admittance.
- There is a potential misperception that simply exposing students to technology as a tool or offering an hour of programming experience is equivalent to offering them the true CS education pathways that are needed to make students college and career ready.
- Lower income schools do not teach CS at the rate of higher income schools. Potentially, without the exposure to CS and the ability to enter into the 1,400,000 (and counting) CS-related jobs that will be unfilled and available by 2020[4], this economic disadvantage continues to be a vicious circle.

This survey creates a clearer picture of CS education in US high schools than we've had to date. At the local community, state, and national levels, this data can help inform continued and more thoughtful discussions about curriculum pathways, course design, funding for CS courses, come to a shared definition and help to solve the puzzle of teacher certification and other education policy issues. We must ensure that all US students have access to modern curriculum and classes, including consistently defined computer science courses,

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[4] U.S. Bureau of Labor and Statistics, *2014-2015 Occupational Outlook Handbook*, January 2014. The OOH reflects BLS employment projections for the 2012-22 decade.

that will enable them to be college and career ready and contributing citizens today and in the future.

Recommended action items for the CS Community:
- Count computer science courses toward high school graduation requirement in all 50 States and the District of Columbia and Puerto Rico.
- Come to an agreement about what we consider as a rigorous, comprehensive computer science curriculum, as well as how to implement common standards in all states and districts.
- Even though computer science classes may count toward a math or science credit, administrators must ensure that they are actually regarded as such.
- Create a national funding plan so that all students have equitable access to computer science education.

*To review the complete results from this survey, as well as previous CSTA High School surveys, please visit http://csta.acm.org/Research/sub/HighSchoolSurveys.html. The CSTA Research Committee is currently developing a new study to capture more data that will help inform the state of secondary computer science education in the classroom.*