

Encouraging Students Toward Computer Science Learning

Students who have been told by parents or teachers they would be good at computer science (CS) are 2.5 to three times more likely to be interested in learning CS in the future, but students do not receive this encouragement equally. Additionally, despite positive perceptions about the CS field, lower personal perceptions of skills in math and science and a self-perceived low ability to learn CS may contribute to a gap in interest in CS among underrepresented groups that starts as early as age 14. This report summarizes key differences in interest in and confidence to learn CS among seventh- to 12th-grade students from underrepresented groups — girls, Black students and Hispanic students — as well as the level of encouragement to learn CS that these groups receive from key influencers such as parents and teachers, based on 2015-2016 surveys.

Background

Research suggests¹ that biases — social stereotypes about certain groups of people that individuals hold consciously or unconsciously — among teachers and parents are likely to be consequential to student educational outcomes. This is particularly problematic for underrepresented students (female, Black and Hispanic) in the CS field given the link between CS knowledge and economic opportunities. Existing research demonstrates gaps in interest and perceptions of STEM-related (science, technology, engineering and math) fields begin at a young age and widen as one gets older — highlighting the pivotal role of primary and secondary education and parents in reducing or eliminating biases in CS.

This report summarizes key differences in interest in and confidence to learn CS among seventh- to 12th-grade students from underrepresented groups — girls, Black and Hispanic students — as well as the level of encouragement to learn CS that these groups receive from parents and teachers. This report also explores how biases may influence well-intentioned teachers and parents in their judgment toward particular students, which may affect instructional practice, expectations and encouragement.

Findings

Learning CS

More than half (55%) of students in the seventh through 12th grades say they have ever learned any CS, such as using programming to create software, apps, games, websites or electronics, but CS-learning participation are not consistent across students:

- Boys (59%) are more likely to have learned CS than girls (50%)
- Black students (62%) are more likely than White (53%) or Hispanic (54%) students to say they have ever learned CS
- CS learning is least common in the Midwest (51%) and West (52%)² and in city (52%) or rural/small town (53%) areas.

While the gap between girls and boys holds for White (60% of boys vs. 45% of girls) and Hispanic (58% vs. 50%) students, it does not hold true among Black students, where 59% of boys and 66% of girls have ever learned any CS.

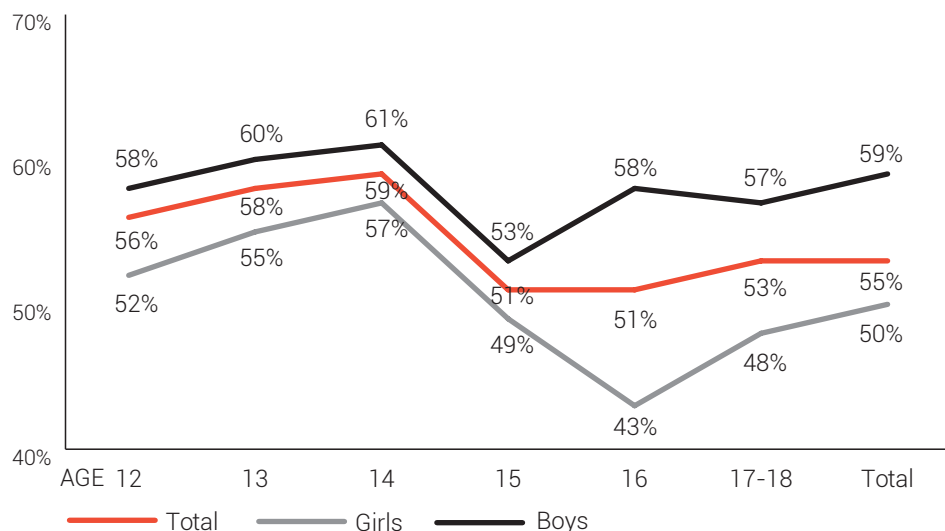
For both boys and girls, reported learning of CS peaks at age 14 (61% and 57%, respectively), then generally drops for both groups.

¹ Dee, T., & Gershenson, S. (2017). Unconscious Bias in the Classroom: Evidence and Opportunities. Mountain View, CA: Google Inc. Retrieved from <https://goo.gl/O6Btqi>
² Based on U.S. Census region definitions. <https://www.census.gov/geo/reference/webatlas/regions.html>

Figure 1

EVER LEARNED ANY CS BY STUDENT AGE AND GENDER %YES

%Students



While the vast majority (80%) of seventh- to 12th-grade students who learned CS learned it in a class at school, **boys are more likely** than girls to have taken outside steps to learn CS through a club or group at school (29% boys vs. 22% girls) and to learn CS through an online class or program (44% boys vs. 31% girls).

Black students are much more likely than White students to have learned in either a club or group at school (34% vs. 18%) or a formal group or program outside of school (38% vs. 17%).

Students' reported learning of CS increases marginally as their household income increases, with 50% of those in households with annual incomes of \$54,000 and below having learned CS, compared with 54% of those in households with incomes of \$54,001 to \$105,000 and 57% in households over \$105,000. While students who've learned CS across incomes are equally likely to have learned in a class at school, lower-income students are more likely to have learned CS in a group or club at school (36% of those with incomes of \$54,000 or below compared with 19% of those with incomes over \$54,000).

Clearly, there are differences in rates of learning CS across demo- and sociographic groups of students starting at an early age which carry into learning CS in college and joining the CS workforce. While some differences may lie in individuals' perceptions of the appeal of CS, students may be influenced by outside factors that can be altered to drive greater interest and participation in the future. Understanding both these intrinsic and extrinsic factors is key to working toward greater female and underrepresented-minority participation in CS.

Perceptions of CS

While we found differences in students who have learned CS, we do not find any major differences in perceptions of CS by gender or race/ethnicity. Seventh- through 12th-grade **boys and girls** as well as **White, Black and Hispanic students** have near identical perceptions of most aspects of CS with all students believing:

- People who do CS need to be very smart (53% of boys and 53% of girls; 55% of White, 50% Black and 56% Hispanic)
- People who do CS make things that help improve people's lives (93% of boys and 93% of girls; 94% of White, 91% Black and 91% Hispanic)
- People who do CS have the opportunity to work on fun and exciting projects (93% of boys and 94% of girls; 94% of White, 98% Black and 91% Hispanic)
- CS can be used in a lot of different types of jobs (96% of boys and 98% of girls ; 97% of White, 98% Black and 96% Hispanic)

Interestingly, 14- and 15-year-old girls (44%) are least likely to think that people who do CS need to be very smart, compared with younger (53% of 12- to 13-year-olds) or older (54% of 16- to 18-year-olds) girls.

While perceptions of the CS field are similar, self-perception of the skills needed for CS plays a role in interest in learning,³ and while girls, overall, feel they are as or more skilled than boys in English, music, searching the internet and working with others, **girls are much less likely** than boys to:

- Feel they are skilled in STEM classes like math (37% of girls vs. 48% of boys) or science (33% girls vs. 48% boys)
- Be very confident they could learn CS if they wanted to (48% girls vs. 65% boys)
- Say they are very likely to have a job someday where they need to know CS (22% of girls vs. 35% of boys)

Other than in math, **Black students are more likely than White** students to feel they are skilled in the different topic areas and more likely to be very confident they could learn CS if they wanted to (68% vs. 56%).

Figure 2

STUDENT PERCEPTIONS ABOUT SELF-SKILLS AND CS

%Students

	Boys (n=901)	Girls (n=771)	White (n=1,033)	Black (n=228)	Hispanic (n=310)
Very Skilled in:					
Math	48%	37%	44%	42%	39%
Science	48%	33%	41%	50%	36%
English	46%	60%	54%	60%	44%
Music	36%	48%	38%	50%	43%
Sports	50%	33%	39%	53%	43%
Science	48%	33%	41%	50%	36%
Searching the internet	66%	63%	63%	71%	65%
Working with others	61%	60%	58%	66%	60%
How confident are you that you could learn CS if you wanted to? (Very Confident)	65%	48%	56%	68%	51%
How likely are you to have a job someday where you would need to know some CS? (Very Likely)	35%	22%	26%	30%	38%

Helping girls see their potential in the CS field and the many ways CS can connect to their potential dream jobs may help encourage more girls to pursue CS.

Interest in Learning CS

Interestingly, at about age 12, boys (30%) and girls (27%) have a similar level of interest in learning CS. However, girls' interest in learning CS decreases between ages 12 and 14 (27% to 12%) while boys' increases (30% to 47%, making this a key opportunity window for children in CS learning). Both boys and girls show a decrease in expressed interest between ages 15 and 17 to 18 (22% and 12%, respectively at age 17 to 18).

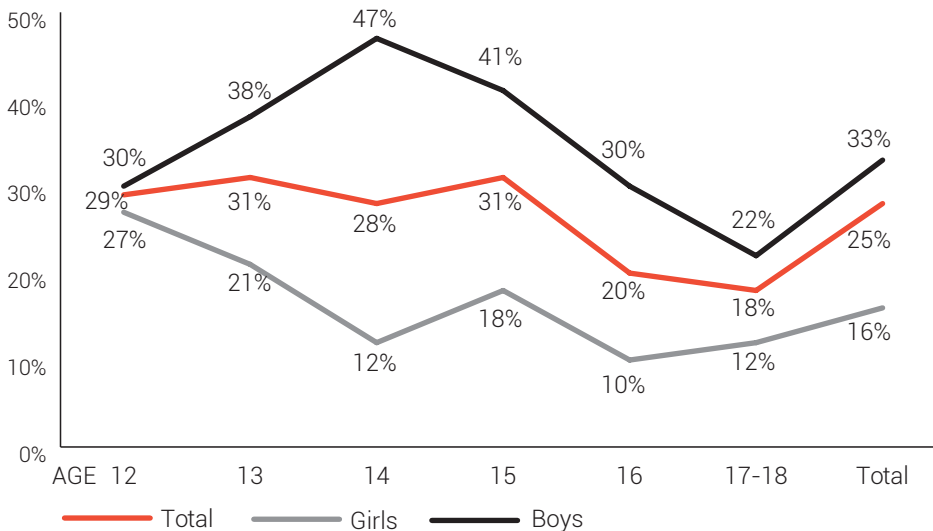
³ Perceived person skill in math correlates to interest in learning CS in future ($r=.146$ $p<.00$). Perceived skill in science has $r=.176$ $p<.00$, while perceived skills in English, music, sports and working with others all have $r<.02$ $p>.2$.

While boys are a bit more likely to have learned any CS than girls, they are twice as likely (34%) as girls (16%) to want to learn CS in the future.

Figure 3

HOW INTERESTED ARE YOU IN LEARNING CS IN THE FUTURE? % VERY INTERESTED

%Students



Despite the current underrepresentation of Blacks and Hispanics in CS college degrees and in the CS workforce, Black (31%) and Hispanic (35%) middle and high school students are more likely to be very interested in learning CS than their White counterparts (21%), which could be an encouraging sign for their participation in the future CS workforce. This is reinforced by reports from parents regarding future CS learning. **Black parents** whose children have already learned some CS are more likely:

- To say their children would be very likely to learn more CS in the future, compared with White or Hispanic parents (85% Black parents vs. 62% White or 65% Hispanic parents).
- To say they want their children to learn more CS, compared with White or Hispanic parents (100% Black parents vs. 95% of White and Hispanic parents)
- To say their children want to learn more CS, compared with White parents (91% Black vs. 83% White)

Despite higher interest among underrepresented minorities, Black girls (15%) and Hispanic girls (21%) are no more likely than their White counterparts (14%) to be interested in CS. Black male (44%) and Hispanic male (45%) students' interest boosts the overall high interest among Black and Hispanic students, so additional efforts need to be taken to address gender differences within all races/ethnicities.

Students' self-confidence in their ability to learn CS if they wanted to correlates to interest in learning more CS in the future ($r = .41$ $p < .00$). Specifically, students who are very confident they could learn CS (37%) are nearly four times more interested in learning CS than those who are less than very confident (10%). While girls' confidence in learning CS drops from age 12 to 14 (from 51% to 43%) and recovers some at age 15, and with the correlation with much lower interest in CS, low confidence and interest are likely key barriers to girls' participation in CS.

Extrinsic vs. Intrinsic Barriers to CS

Biases can be influenced by both intrinsic and extrinsic factors (i.e., factors internal to students such as interest and factors external to students such as opportunity and role models) each requiring uniquely developed and theoretically informed unbiasing interventions. There is a body of research suggesting that dominant groups are less likely to think there are extrinsic or structural barriers and more likely to think there are intrinsic barriers for girls and underrepresented

minorities.⁴ This research seems to be at least partially validated by Google-Gallup data considering parents' or teachers' perceptions of why women are less likely to work in the CS field.

Male teachers and parents are less likely than females to believe that extrinsic barriers explain lack of female participation. **Male teachers are less likely** than female teachers to think that the following extrinsic barriers are major reasons women are less likely to work in the CS field:

- The lack of opportunity to learn CS (34% male teachers vs. 42% female teachers)
- The lack of exposure to CS (43% male teachers vs. 54% female teachers)
- The lack of role models in CS (48% male teachers vs. 58% female teachers)

Male parents demonstrate similar patterns to male teachers.

However, there are no differences between male and female teachers regarding whether an intrinsic lack of interest or motivation (36% vs. 31%) and lack of encouragement from others (39% vs. 44%) play major roles in women's lower participation in CS.

Male parents (43%), however, are more likely to indicate that either lack of interest or lack of motivation is the primary reason for women's underrepresentation in the CS field, potentially indicating they are more likely to believe that the lack of females in CS is partially explained by choice. In contrast, both male and female teachers and female parents rate interest or motivation **as one of the bottom two** major reasons why women aren't in CS. Believing that the lack of females in CS is affected by their interest in CS and not outside barriers such as encouragement and role models may make fathers less likely to encourage their daughters to pursue the field of CS if they sense their daughters are not interested (e.g., they do not see them playing computer games or hear them expressing verbal interest).

Some of the decrease in interest among students in CS as they enter high school could potentially be explained by high school teachers' personal beliefs. **High school teachers are less likely** than lower-grade teachers to say that:

- Lack of exposure is a major reason women (48% high school vs. 54% lower-grade teachers) and minorities (60% high school vs. 67% lower-grade teachers) are less prevalent in the CS field
- Lack of opportunity to learn CS (53% high school vs. 65% lower-grade teachers) is a major reason minorities are less represented in CS

Some teachers may feel that high school students within their schools have equal exposure and opportunity to learn CS and thus do not see these as reasons for lower participation, meaning they may not make extra efforts to promote CS and encourage students to learn it, especially students who do not explicitly show interest or experience.

In contrast to the view of why women are less likely to be in the CS field, when asked about reasons certain minorities are underrepresented, White parents are significantly less likely than either Black or Hispanic parents to say any of the five reasons are major reasons.

Compared to White or Black parents, **Hispanic parents are more likely** to say lack of interest or motivation to learn CS is a major reason and most likely to name lack of opportunity to learn CS as the top reason, while it appears fourth of five in rank order by both White and Black parents.

⁴ Dee, T., & Gershenson, S. (2017). Unconscious Bias in the Classroom: Evidence and Opportunities. Mountain View, CA: Google Inc. Retrieved from <https://goo.gl/O6Btqi>.

Figure 4

CERTAIN RACIAL AND ETHNIC GROUPS, LIKE AFRICAN-AMERICANS AND LATINOS, ARE LESS LIKELY TO WORK IN THE COMPUTER SCIENCE FIELD. PLEASE TELL ME WHETHER YOU THINK EACH OF THE FOLLOWING IS A MAJOR REASON, A MINOR REASON OR NOT A REASON WHY THIS IS. HOW ABOUT ... ? (% MAJOR REASON)

%Parent

	WHITE		BLACK		HISPANIC	
	(n=1,145)	Rank	(n=197)	Rank	(n=264)	Rank
Lack of opportunity to learn CS	48%	4	61%	4	65%	1
Lack of interest or motivation to learn CS	38%	5	46%	5	54%	5
Lack of exposure to CS	52%	2	66%	2	63%	4
Lack of encouragement from others to learn CS	51%	3	62%	3	64%	3
Lack of role models in CS	53%	1	67%	1	65%	1

Encouragement to Learn CS

The perceptual differences between male and female parents and teachers are important as these individuals spend a substantial amount of time with children and therefore play a major role in shaping their education and career pathways. Parents and teachers telling students they would be good in CS has the largest effect on students' interest in learning CS of any metric used in the survey.

Students who were told they would be good at CS by a parent are more than three times as likely to be interested in learning CS in the future (49% vs. 13%). A teacher's perspective also plays a critical role in encouraging student interest in learning CS. Students told by teachers they would be good at CS are 2.5 times more likely to be interested in learning CS (43% vs. 17%). While we are not able to determine the direct causality, being told by a parent ($r = .37$ $p < .00$) or teacher ($r = .32$ $p < .00$) that one would be good at CS is directly correlated with a student's interest in learning CS in the future.

Being encouraged to learn CS by parents and teachers could also have additional benefits. **Students who were encouraged** by parents were also more likely to:

- Have learned CS (69% encouraged vs. 46% non-encouraged students)
- Have learned CS online (50% encouraged vs. 28% non-encouraged students), in a formal group outside of school (29% vs. 15%), or in a group or club at school (34% vs. 19%)
- Say they are very skilled in math (49% encouraged vs. 39% non-encouraged students), science (49% vs. 36%) and searching the internet (77% vs. 58%)

However, there are no differences between those who were encouraged and those who were not on whether students indicated that they were very skilled in English (55% vs. 51%), music (44% vs. 40%), sports (41% vs. 43%) or working with others (63% vs. 59%). Similar patterns are seen for those who were told they are good at CS by a teacher.

Figure 5

STUDENT CS LEARNING AND PERCEPTIONS ABOUT SELF-SKILLS

	Parent Told Good at CS		Teacher Told Good at CS	
	Yes (n=594)	No (n=9,783)	Yes (n=533)	No (n=1,033)
Have ever learned any CS? (Yes)	69%	46%	73%	46%
Among those who learned any CS, learned CS in:				
Online program	50%	28%	50%	29%
Class at school	80%	81%	86%	76%
Outside of school in formal group	29%	15%	30%	15%
After school club or group at school	34%	19%	35%	20%
Feel Very Skilled in:				
Math	49%	39%	52%	38%
Science	49%	36%	49%	38%
English	55%	51%	52%	53%
Music	44%	40%	43%	41%
Sports	41%	43%	46%	40%
Searching the internet	77%	58%	72%	61%
Working with others	63%	59%	59%	61%

While one-third or more of students in grades seven to 12 have been told they would be good at CS by a parent (37%) or teacher (33%), not all children are being equally encouraged by parents and teachers.

Boys are much more likely than girls to have been told by teachers they would be good at CS (39% vs. 26%). The gap is even wider for encouragement from parents, with 46% of boys having been told by a parent they would be good at CS compared with just 27% of girls.

The encouragement gap in gender remains even when girls themselves are interested in learning CS in the future or feel they are skilled at science and math. Girls who are very interested in learning CS in the future are less likely than CS-interested boys to have been told by a parent (54% vs. 72%) that they would be good in CS. And even girls who feel they are very skilled in math (33%) and science (30%) are less likely than their counterpart boys (49% and 53%, respectively) to have been told they would be good in CS.

Teachers may see a student's inherent interest in CS more in the classroom, as teachers are as likely to tell girls who are interested in learning CS in the future that they would be good at CS (55%) as they are to tell boys (57%) they would be good.

In contrast to representation in the CS field, Black students are more likely than White students to have been told by teachers (40% vs. 32%) or parents (43% vs. 35%) they would be good at CS. Hispanic students are about as likely to have been told by a parent as Black students (though they do not have as high a level of teacher support). However, the gap between girls and boys holds true across race and ethnicity, with an especially big gap for Hispanic girls (19% vs. 46% of

boys) being told by a teacher they would be good at CS. Interestingly, students in city (39%) and rural/small town (34%) areas are more likely than those in suburban (27%) areas to have been told they would be good at CS by a teacher.

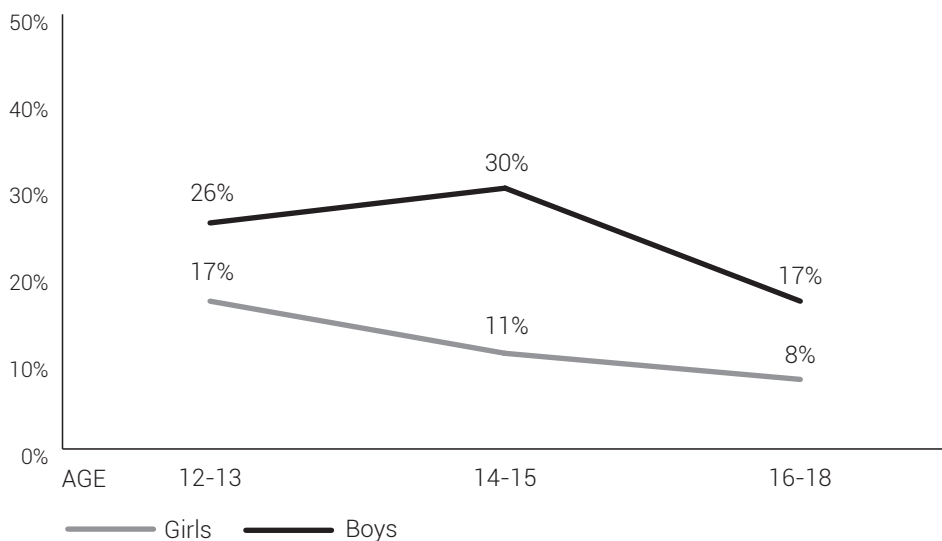
And while lower-income students are not more likely to say a parent has told them they would be good at CS (39% in households with incomes of \$54,000 or less vs. 35% of households with incomes over \$105,000), they are more likely to report that a teacher has told them they would be good at CS (39% vs 27%). These findings, counter to reported literature, may be a result of recent efforts to focus on underrepresented minorities, especially in urban areas.

CS Role Models

While girls are about as likely as boys to say they often see or read about people doing CS on TV (21% vs. 25%) and in movies (23% vs. 28%), girls exposed to people in the media doing CS (11%) are only half as likely as boys (21%) to say they often see people like themselves doing CS. The likelihood of girls saying that they often see someone like themselves doing CS decreases by half between 12- to 13-year-olds and 16- to 18-year-olds, while for boys, likelihood decreases by just over one-third over the same ages.

Figure 6

THINKING ABOUT ALL OF THE PEOPLE YOU SEE OR READ ABOUT DOING COMPUTER SCIENCE IN TV SHOWS, IN MOVIES, OR ONLINE, HOW OFTEN DO YOU SEE PEOPLE LIKE YOU DOING COMPUTER SCIENCE? % OFTEN



Black students are more likely than White or Hispanic students to say they "often" see or read about people doing CS in:

- TV shows (34% of Black compared with 20% of White and 23% of Hispanic students)
- Movies (36% vs. 24% and 23%)

Among students who often or sometimes see people doing CS on TV, in movies or online, Black students are much more likely (26%) to say they often see people like themselves doing CS than their White (16%) or Hispanic (13%) counterparts, suggesting they have more role models in the media they watch for CS. When it comes to personal CS role models, Hispanic students are much less likely (49%) than White (68%) or Black (65%) students to have an adult in their lives who works with computers or other types of technology.

Social and media stereotypes can limit the role models for some groups and make it more difficult for members of those groups to see themselves in a role, particularly if they are not supported in other ways to counteract the social norms. Finding ways to encourage and highlight underrepresented minorities in CS roles in social and public media may have a positive effect on students.

Recommendations

Our findings indicate that it is important to understand both the intrinsic and extrinsic barriers keeping students from being interested in and pursuing CS education and careers. Interest among girls for CS starts to wane as early as age 14, despite positive perceptions about the CS field overall (perceptions about CS do not change according to a child's age). Lower personal perceptions of skill in science and math and a self-perceived inability to learn CS may hold girls back. Further, our research finds that, contrary to much existing literature, Hispanic and Black students are as or more likely than White students to have been encouraged in CS by teachers and parents, as well as to have higher interest in learning CS in the future. This may be a new phenomenon being captured after recent efforts in schools and communities to support CS among underrepresented minorities.

Encouragement and affirmation from parents and teachers is directly correlated to student interest in learning CS. It can positively shape students' own attitudes and expectations about CS and influence their future fields of study and careers. This brief reveals that in order to positively support students' own attitudes and expectations, we must:

- **Leverage the high opinion of CS** held by many seventh- to 12th-grade students (including those from underrepresented groups) and key influencers to shine a light on the benefits of CS paths for girls, Black students and Hispanic students
- **Find ways to help parents and teachers talk to underrepresented students about CS**, providing materials and conversation starters that are relevant and adaptable across diverse student populations
- **Encourage early exposure to role models for girls**, especially before age 14, in both classroom environments and popular media (e.g., social media as well as more broadly in TV and print media)
- **Establish individualized support for students** rather than making assumptions about groups; educators, parents and other role models should be encouraged to consider individuals based upon unique attributes rather than demographic assumptions

Encouraging Students Toward Computer Science Learning

Data Tables

Google commissioned Gallup to conduct a multiyear, comprehensive research effort to better understand CS perceptions, access and learning opportunities among underrepresented groups in the U.S. Results are from Year 2 of this study of U.S. students, parents, teachers, principals and superintendents. The below data tables show summaries of responses from representative samples of 1,672 seventh- to 12th-grade students and 1,677 parents of seventh to 12th graders in the U.S., as well as 1,008 first- to 12th-grade teachers surveyed 2015–2016. Sample sizes may vary by question. See g.co/cseduceresearch for methodology in the full Trends in the State of Computer Science in U.S. K-12 Schools report.

STUDENTS	Total (n=951)	Boys (n=548)	Girls (n=403)	White (n=584)	Black (n=140)	Hispanic (n=173)
Have you ever learned computer science in any of the following ways? (asked only of students who have learned CS) (% Yes)						
In a class at school	80	80	81	81	82	80
In a group or club at school	26	29	22	18	34	41
In a formal group or program outside of school	22	22	20	17	38	21
Online through a class, program or online community	39	44	31	38	38	37
STUDENTS	Total (n=1,672)	Boys (n=901)	Girls (n=771)	White (n=1,033)	Black (n=228)	Hispanic (n=310)
Have you ever learned any CS, such as using programming to create software, apps, games, websites or electronics? (% Yes)	55	59	50	53	62	54
How interested are you in learning CS in the future? (% very interested/somewhat interested)	25/56	34/54	16/60	21/59	31/57	35/49
How confident are you that you could learn CS if you wanted to? (% very confident/somewhat confident)	57/36	65/29	48/45	56/38	68/28	51/39
Has a teacher ever told you that you would be good at CS? (% Yes)	33	39	26	32	40	34
Among girls				27	37	19
Among boys				36	43	46

Has a parent ever told you that you would be good at CS? (% Yes)	37	46	27	35	43	41
Among girls				26	20	25
Among boys				43	53	52
People who do CS need to be very smart. (% Agree)	53	53	53	55	50	56
People who do CS make things that help improve people's lives. (% Agree)	93	93	93	94	91	91
People who do CS have the opportunity to work on fun and exciting projects. (% Agree)	94	93	94	94	98	91
CS can be used in a lot of different types of jobs. (% Agree)	97	96	98	97	98	96

	PARENTS			TEACHERS		
Women are less likely than men to work in the CS field. Please tell me whether you think each of the following is a major reason, a minor reason or not a reason why this is. (% major reason)	Total (n=1,672)	Male (n=861)	Female (n=816)	Total (n=1,008)	Male (n=335)	Female (n=673)
Lack of opportunity to learn CS	38	31	43	40	34	42
Lack of interest or motivation to learn CS	42	43	41	32	36	31
Lack of exposure to CS	41	35	47	51	43	54
Lack of encouragement from others to learn CS	40	39	39	43	39	44
Lack of role models in CS	44	40	48	55	48	58

Suggested citation: Google Inc. & Gallup Inc. (2017, December). Encouraging Students Toward Computer Science Learning. Results From the 2015-2016 Google-Gallup Study of Computer Science in U.S. K-12 Schools (Issue Brief No. 5). Retrieved from <https://goo.gl/iM5g3A>.