The Hour of Code: Impact on Attitudes Towards and Self-Efficacy with Computer Science

Abstract

This survey study aimed to assess whether or not students' attitudes towards and self-efficacy with computer science changed after engaging with an Hour of Code activity. Findings show that after completing one Hour of Code activity, students' positive attitudes towards computer science increase along with feelings of computer science self-efficacy, especially for female students. In other words, after just one Hour of Code activity, students report liking computer science more and report feeling that they are better able to learn computer science and are better at computer science than their peers. These findings suggest that using particular activities in the right context can produce large changes in attitudes towards and self-efficacy with computer science.

Purpose

Computer science educators and researchers have been working to understand why female and minority students continue to be underrepresented in the field[1]. Stereotypes around who is capable of doing computer science have emerged as one factor contributing to this issue. Another factor, which is not unique to computer science, is whether or not students have positive attitudes towards the discipline. Without positive attitudes, it's difficult to engage anyone in any subject matter. Without engaging students in the subject, it is difficult to dispel the stereotype that computer science is only for some people. Therefore, the Hour of Code attempts to expose students to computer science in the interest of changing any misconceptions they may have about the field. Since the Hour of Code campaign started in 2013, tens of millions of students have taken part in an Hour of Code activity, and educators around the country have anecdotally reported how fun and engaging these activities are for students. However, we have not systematically studied whether or not this is perceived or actual excitement. To this end, we ask the following research question: Do students report a change in attitudes towards or self-efficacy with computer science after engaging in an Hour of Code activity? How do changes differ based on age, gender, or prior experience?

[1] Master, A., Cheryan, S., & Meltzoff, A. N. (2016). Computing whether she belongs: Stereotypes undermine girls' interest and sense of belonging in computer science. *Journal of Educational Psychology*, *108*(3), 424.; Pajares, F. (1996). Self-efficacy beliefs in academic settings. *Review of Educational Research*, *66*(4), 543-578.; Unfried, A., Faber, M., & Wiebe, E. N. (2014, April). Gender and Student Attitudes toward Science, Technology, Engineering, and Mathematics. Presented at the AERA Annual Meeting, Philadelphia, PA.

Methodology

Immediately before beginning and ending the Hour of Code activity, students were asked, on a 4-point likert scale[2], their level of agreement with the following statements:

- I like Computer Science.
- I think Computer Science is interesting.
- I have the ability to learn Computer Science.
- I am better at Computer Science than most kids at my school.

Note that the first two statements comprise the construct of “attitude” in this study, while the second two comprise the construct of “self-efficacy” in this study.

The pre-survey had one additional question so that we could gauge student’s prior experience with computer science. Students were given the following three options: never done an Hour of Code, only done an Hour of Code, done more computer science than an Hour of Code. Additionally, we were able to match some students to gender if they or their teacher had previously chosen to report the student’s gender.

Setting & Participants

This study was conducted online over the course of five days in December 2016 as part of Computer Science Education Week. 563 classrooms took part in the study. Teachers voluntarily opted into the study after receiving an email from Code.org about the opportunity. They were offered $10 gift cards in exchange for enrolling their classrooms into the study. Teachers were given the option to use one of two different Hour of Code activities created by Code.org. One activity, “Flappy Code”, was suggested for younger students. “Flappy Code” is a short 10-level tutorial where students get to build their own game. The other choice was the “Classic Maze”, a more intensive, 20- level tutorial, suggested for slightly older students.

8,040 students completed at least one question on both the pre- and post-Hour of Code surveys, and 48% (3,891) reported gender. Of those who reported, 47% identified as female, and 53% identified as male. Students or teachers also provided information on student age, a required part of various sign-in processes. 41% were elementary school ages or younger (10 or younger), 45% were middle school ages (11-13), and 14% were high school aged or older (14 and older).

[2] Students were able to select from the following four options to rate their level of agreement with each statement: disagree a lot, disagree a little, agree a little, agree a lot.

Table: Survey respondents by age and gender

	Elementary school	Middle school	High school	Total
Female Students	708	863	265	1836
Male Students	682	1009	364	2055
Gender Unknown	1883	1783	483	4149
Total	3273	3655	1112	**8040**

Analysis

We compared student responses before and after participating in the Hour of Code activities by converting Likert scale responses (disagree a lot, disagree a little, agree a little, agree a lot) onto a continuous numerical scale (1-4, respectively). All comparisons were conducted using paired t-tests.

Findings

For both constructs measured, attitudes and self-efficacy, positive increases occurred across the board when looking at the study participants in aggregate. In the table below, we share the overall findings for each likert-scale item. While all of the findings here are statistically significant at the .01 level, they may not be considered conceptually meaningful when examining the likert-scale increases and the absolute change for the percent who agree. That said, when the data is disaggregated, there are many results that could be considered conceptually meaningful.

Table: Aggregate results by statement

	N	Pre Hour of Code likert-scale rating	Post Hour of Code likert-scale rating	Absolute change in % who agree[3]
I think computer science is interesting.	7979	3.18	3.34**[4]	3.8%
I like computer science.	8018	3.12	3.30**	3.4%
I am better at computer science than most kids at my school.	8024	2.30	2.53**	11.1%
I have the ability to learn computer science.	7995	3.40	3.44	.3%

[3] Absolute change in percent who agree represents the percentage of respondents whose answers changed from disagree to agree on the likert scale.

[4] Anything denoted with ** was statistically significant at the .01 level, meaning there is less than a 1% chance that the differences observed between responses before and after the Hour of Code would have been observed due to random sampling error.

Statistically significant differences were not found when examining if the two tutorials in which students engaged produced different results. It was expected that the Flappy Code tutorial would produce more positive results as it's designed to be simpler and more fun. However, it was found that even a more intensive tutorial like the Classic Maze brought about similar positive increases in student responses. Given that differences didn't emerge by tutorial, that analysis is not included as part of the findings shared in this report.

Other than the aggregate findings share in the table above, findings that demonstrate what can be considered the largest conceptual shifts in attitudes towards and interest in computer science are shared in this report by likert-item statement. There is more extensive analysis that can be done with these data, you are invited to examine it all here: (Google Spreadsheet, CSV file, Excel)

I like computer science

When examining the largest changes from pre- to post- for the statement, "I like computer science", the findings suggest that female students' attitudes towards computer science were the most positively impacted by the Hour of Code activities.

Table: 5 largest increases in perception shift for "I like computer science"

Student Gender	Age Group	Prior Experience	N	Pre Hour of Code likert-scale rating	Post Hour of Code likert-scale rating	Absolute change in % who agree
Female	High school	Never done an Hour of Code	158	2.42	2.78**	20.3%
Female	High school	All	265	2.59	2.88**	17.7%
All	High school	Never done an Hour of Code	513	2.64	2.91**	11.1%
Female	All	Never done an Hour of Code	644	2.76	3.06**	10.1%
Female	Middle school	Never done an Hour of Code	286	2.66	2.98**	9.4%

Notably, four of the largest observable shift in perceptions related to liking computer science are all for middle school and high school females with no prior computer science experience. While males had many statistically significant increases in this category, they were not as dramatic as those for female students. These results are heartening, as females are underrepresented in computer science and Code.org works to serve females in particular. Studies have shown that

more generally, females have less positive attitudes towards and self-efficacy with disciplines in the STEM fields, and it is one of Code.org's chief goals to change this.

Age mattered more for female students than it did for male students. High school aged females have the highest rate of change, showing that just one experience can influence perceptions of computer science. It is often assumed that it's more difficult to change the minds of students as they get older; this data show that students, and especially females, should be exposed to computer science at all grade levels.

Table: Absolute change in %age of students who report liking Computer Science after completing an Hour of Code tutorial

	Elementary School (~10 or younger)	**Middle School (~11-13 years old)**	**High School (14 and older)**
Female Students	2.1% (n=705)	6.2% (860)	17.7% (n=265)
Male Students	-.4% (n=681)	2.7% (1006)	2.5% (n=363)

I think computer science is interesting

When examining the largest changes from pre- to post- for the statement, "I think computer science is interesting", female students of all ages reported the largest gains in terms of thinking computer science is interesting, regardless of prior experience with computer science.

Table: 5 largest increases in perception shift for "I think computer science is interesting"

Student Gender	**Age Group**	**Prior Experience**	**N**	**Pre Hour of Code likert-scale rating**	**Post Hour of Code likert-scale rating**	**Absolute change in % who agree**
Female	Middle school	Never done an Hour of Code	287	2.74	3.06**	10.5%
Female	Elementary school	Never done an Hour of Code	198	3.17	3.50**	9.1%
Female	High school	Never done an Hour of Code	156	2.69	2.92**	9.0%
Female	Middle school	Only done an Hour of Code	324	2.87	3.12**	9.0%
Female	Middle school	All	858	2.92	3.16**	8.4%

The results for "I like computer science" and "I think computer science is interesting" followed similar trends. The data indicate that the younger age group a student is in, the more they like

computer science and find it interesting at baseline. The biggest shifts in attitude occur for older students; if you were in an older age group, you were much more likely to change your response from “Disagree” to “Agree” to these two survey questions targeting the construct of attitude.

I have the ability to learn computer science

The results for “I have the ability to learn computer science” didn’t see as much positive movement as in the attitudinal construct, however, they this could be attributed to ceiling effects. For all participants (n=7995) who answered the question “I have the ability to learn Computer Science”, the average pre-Hour of Code rating was 3.21, showing most students already have a growth mindset in reporting that they are able to learn computer science. Additionally, there were fewer statistically significant changes from pre- to post- in response to this statement, including in relation to prior experience.

I am better at computer science than most kids at my school

One of the most striking results was in the change in students’ confidence in how good they are at Computer Science. While the Hour of Code tutorial had a positive impact on middle-school student attitudes towards computer science, it had less impact on their self-efficacy. While most of the data lean toward prior experience being a predictor of how much someone shifts in their perceptions of this statement, the high school females had prior experience but still had large shifts in their perception of their computer science abilities as compared to their peers. If you examine the data in aggregate for age and gender (including unknown) for students who reported never having done an Hour of Code before, there is a significant and meaningful positive change for those students. The table below includes a bonus sixth row that highlights this finding.

Table: 5+ largest increases in perception shift for “I am better at computer science than most kids at my school”

Student Gender	Age Group	Prior Experience	N	Pre Hour of Code likert-scale rating	Post Hour of Code likert-scale rating	Absolute change in % who agree
Female	Elementary school	Only done an Hour of Code	289	2.35	2.61**	18.0%
Male	High school	Never done an Hour of Code	159	2.42	2.67**	16.4%
Female	High school	Done more computer science than	31[5]	2.41	2.65**	16.1%

[5] Due to the smaller sample size here, a test of normality was completed (Chi Square), and the data was found to be normally distributed (p=.013).

		just an Hour of Code				
Male	Elementary school	Never done an Hour of Code	203	2.52	2.78**	15.8%
All	Elementary school	Never done an Hour of Code	1030	2.14	2.35**	15.0%
All	All	Never done an Hour of Code	2788	2.05	2.34**	14%

Regardless of whether examining the data by prior experience, gender, or age group, doing an Hour of Code tutorial resulted in an increase in the percentage of students who felt that they are better than other students at doing Computer Science. Knowing that students perceptions can change substantively across so many different demographic groupings suggests that there may be ways to impact large swaths of students using just one intervention.

Limitations

While this study was carefully conducted, the findings could potentially change if we had more information on student gender across the board. While findings for females of all ages were noted across both constructs, it's possible that these findings might change if we had more knowledge of gender overall. Another limitation of this study is not knowing what happened in each setting during the Hour of Code event. It's possible that teachers who opted into the study are more interested in computer science overall, and this could have influenced student attitudes. Additionally, we have no information on whether changes in student perception were maintained beyond the Hour of Code. Finally, given that we don't have more information related to the demographic breakdown of all the students and that this was an opt-in study, we may not have a representative sample of participants, limiting the generalizability of these findings to all school-aged students.

Conclusion and Implications

Across the board, statistically significant changes were noted in students attitudes towards and self-efficacy with computer science after engaging in just one Hour of Code activity. Given that most student engaged in tutorials for only approximately 40 minutes, these findings demonstrate that with the right activity, simple exposure to computer science may be all that's needed in particular settings to engage more students, especially females, in computer science. This is an important finding for the computer science education community since large, sweeping efforts are currently underway to try to understand what types of interventions change student perceptions of and attitudes towards computer science and other STEM fields.