

# Analysis of Gender Gap in Computer Science in High School

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## ABSTRACT

Computer Science has been a male-dominated field even at its beginning, and it continues to be so. A distinct gap has developed between the number of women and men studying and working in Computer Science, commonly termed as the Gender Gap. Previous studies have uncovered this gap at its worst during college education, where women occupy a small fraction of the STEM-related classes. Surveys and data were taken from a high school to be analyzed. These provide insight into why female students are not as encouraged as their male counterparts regarding the subject. The results show that even at a stage as early as high school, differences in confidence, upbringing and exposure have often deterred female students from pursuing Computer Science. Contrary to the belief that due to the rising dependency on technology more women are pursuing Computer Science, a four-year plot shows that in high schools there is rather a widening gender gap.

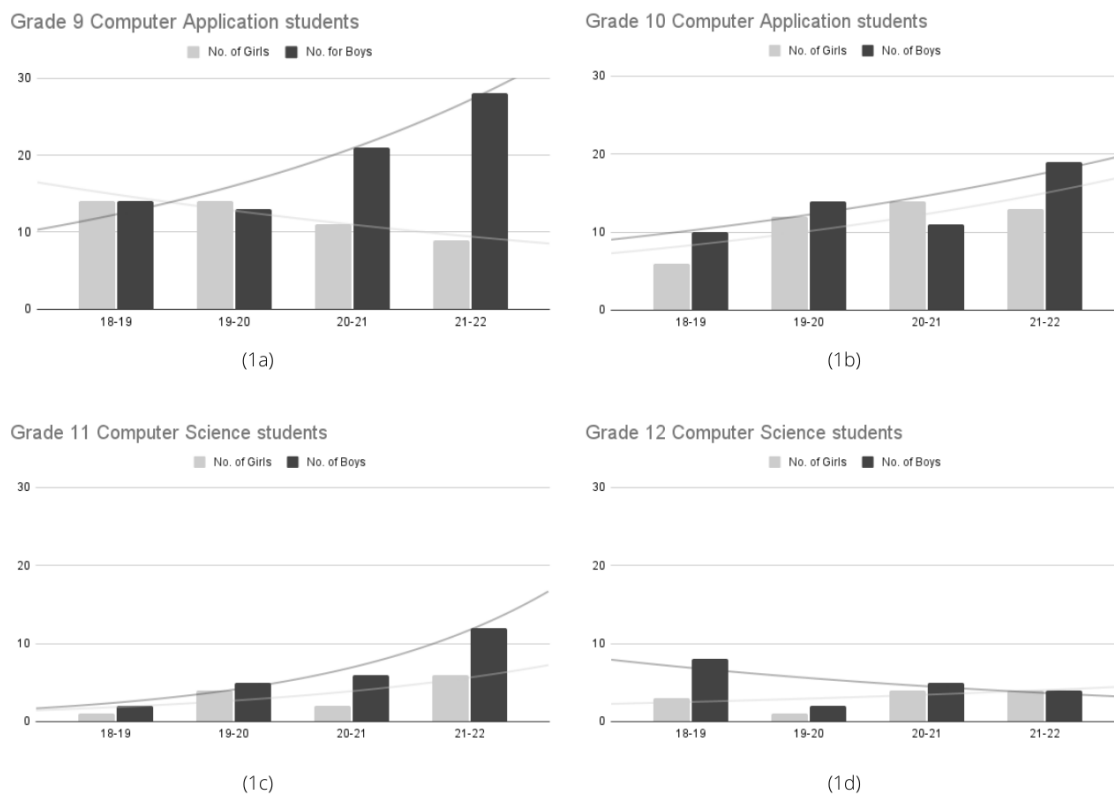
## Introduction

Negative stereotypes have often discouraged women from undertaking computer science as a choice of career (Beyer et al., 2003). Computer Science is not seen as a field fit for women, majorly because of the misconception that they lack the logical ability required to tackle such a profession. Women who do choose to pursue it, are presumed to be out of the ordinary, strengthening the assumption that women do not belong in Computer Science (Henwood et al., 2000). When entering college, female students are not as experienced in the subject as compared to their male counterparts (Powell, 2008). While open course education, online education platforms and an increase in general awareness have helped the situation, the gap persists. From 1996 to 2004 only 16-17 per cent of total students attempting AP Computer Science A, were women (Powell, 2008). The pre-colleges years, that is the K-12 years, are the most essential in the development of interests, the gap that emerges then, is more distinct in higher education (Danoff, 2017). The gap emerges due to a variety of reasons such as parental influence, confidence gap, gender discrimination, etc. Previous research has shown a distinction between the interest shown and the quality of work in Computer Science related projects has further induced a need to have this gap more thoroughly investigated (Tsan et al., 2016).

## The Disparity in Numbers

There is a sizable difference in the numbers of male and female students in elective Computer Applications and Computer Science seen in the selected high school. It has been noted in higher education (undergraduate, graduate, etc) that the number of female students does not only fail to increase but also declines (Vitores & Gil-Juárez, 2016). Subconsciously or consciously, the girls and women are choosing to either not take up a career in Computer Science or to leave it (Spertus, 1991). In 1990, women took up only a third of the total number of undergraduates in MIT (Massachusetts Institute of Technology) (Spertus, 1991), and it has taken them almost 3 decades to bring that number to balance, (Office, M. I. T. N., 2016). Despite these efforts, in 2016 women only took up 19% of the total undergraduate

degrees awarded in the United States (Sanders,2019). The decreasing trend may also be reflected at a high school level.



**Figure 1:** Number of students in IT-specific elective classes over the past 4 years in a high school, (1a) represents the number of boys and girls in grade 9th, (1b) 10th, (1c) 11, and (1d) 12th.

## The Cause

### Parental Influence

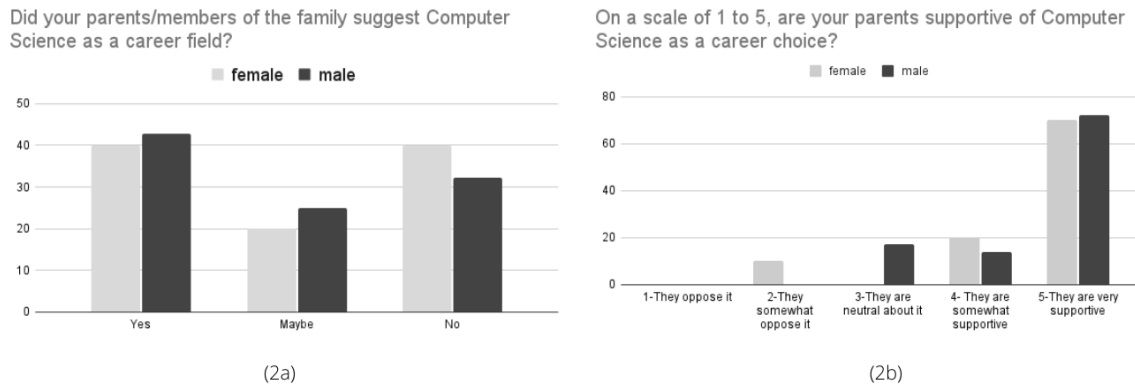
#### *Effect of Upbringing*

Children have an intuitive sense of understanding of the hidden message their parents often tend to relay unintentionally (Jacobsen, 1999). Similarly, parents who act as the gateway to the outside world to their children, present the concept of gender roles (Jungen, 2008). This presentation may be something as seemingly unimpactful as the toys children as first presented and later expected to play with. As boys are given cars to interact with at an early age, they may develop a fascination for the mechanical and engineering aspects of the toy. At the same time, girls are caused to lean towards the design and aesthetics of objects as a result of playing with dolls.

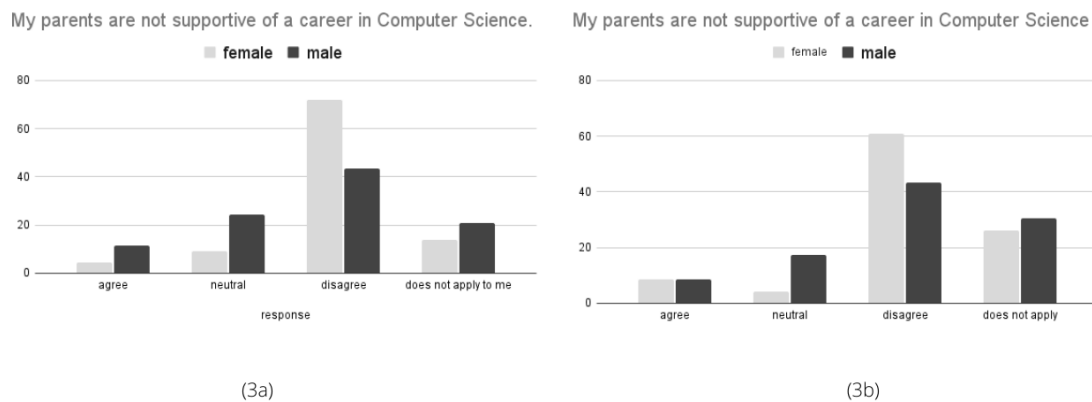
#### *Support Provided in Career Choices*

As per the surveys, parents in privileged environments support Computer Science as a career choice, irrespective of the gender of their ward. However, parents are also not keen on guiding their girl child towards a career in Computer

Science. Parents do not actively promote Computer Science and Engineering as a career to girls (Vrieler et al., 2021). This may be due to stereotypes presented in society regarding those in this career field, the preference of another field or the lack of interest presented by their child in Computer Science.



**Figure 2.** Survey results of students studying Computer Applications/Computer Science in grades 9th and 11th, when asked, (2a) “Did your parents/members of the family suggest Computer Science as a career field?”, and (2b) “On a scale of 1 to 5, are your parents supportive of Computer Science as a career choice?”



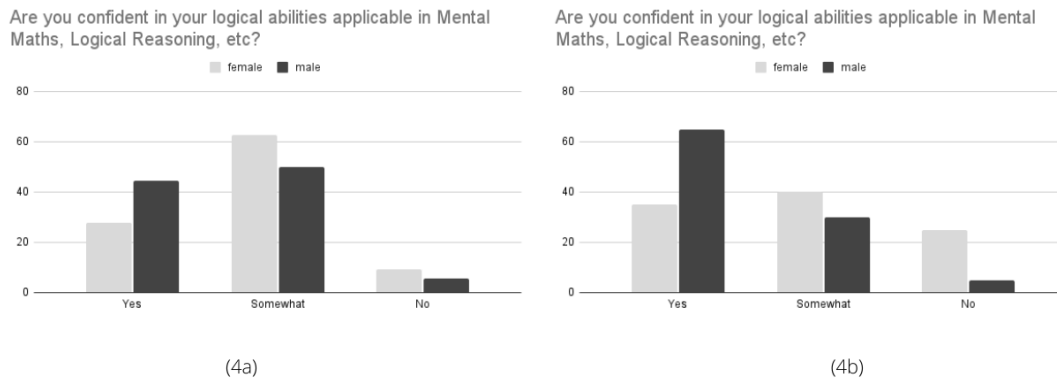
**Figure 3.** Survey results of students when asked “How do you feel about the following statements? [My parents are not supportive of a career in Computer Science.]”. (3a) students in grade 8 studying Computer Applications as a compulsory subject and (3b) students in grade 9 who have opted out of Computer Applications.

### Confidence Gap

A student is more to continue in a field where they are more confident in their abilities. Female students have displayed the tendency to underestimate their abilities towards quantitative subjects (Chiesi & Primi, 2015). This confidence gap results in lesser numbers of female students taking up or showing their interest in Computer Science. Any STEM field is seen as a very analytically demanding career choice and thus logical abilities are an assumed prerequisite. The same can be inferred for Computer Science and coding. Even though coding and analytical skills form a major part of the job, they are not the only things required to succeed in a STEM field.

### Logical abilities

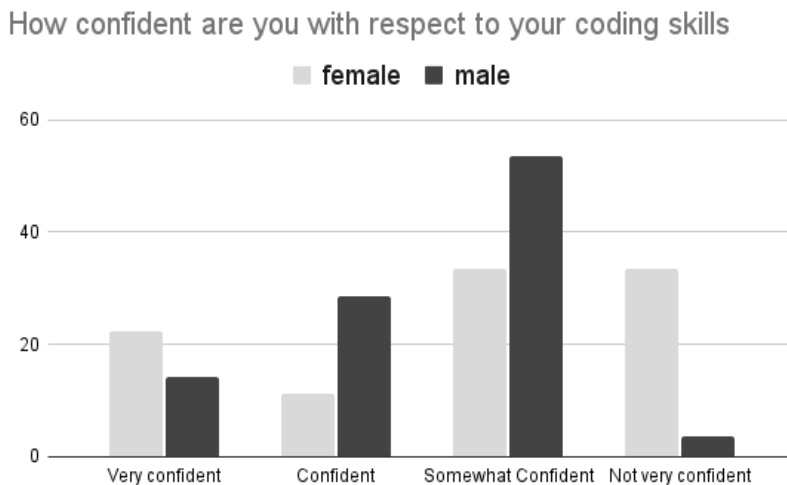
Students in grades 8th and 9th were asked about their confidence in their logical abilities. Grade 8 students study Computer Applications as a compulsory subject, while the 9th-grade students have not taken Computer Science as an elective. As shown in the graphs below, female students in both grades have shown significantly less confidence in their logical abilities. While no scientific research has proven a distinct difference in the logical and mathematical capabilities of male and female students (Kadiri, 2004), it has been found that male students do outperform their female counterparts in the said skillset (Fennema & Sherman, 1978; Adeleke, 2007).



**Figure 4.** Survey results of students when asked, “Are you confident in your logical abilities applicable in Mental Maths, Logical Reasoning, etc?”. (4a) students in grade 8 studying Computer Applications as a compulsory subject and (4b) students in grade 9 who have opted out of Computer Applications

### Coding abilities

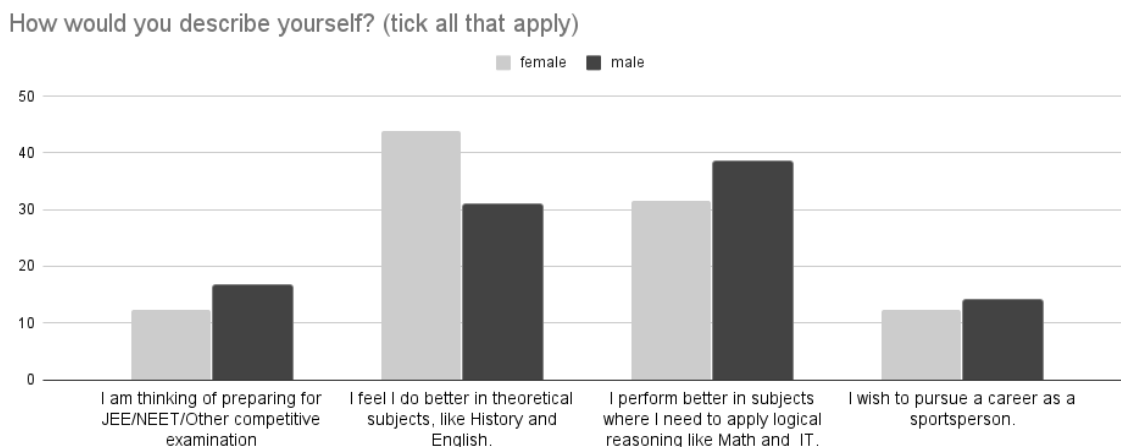
Students in grades 9th and 11th, who have chosen Computer Science as an elective were asked about their confidence in their coding abilities. It is to be noted that female students form a rather small fraction of the total number of students studying Computer Science. The graphs below show that even when treated with the same difficulty level of coursework, girls were more likely to call themselves unconfident in their abilities, compared to boys, who majorly seem confident. This confidence gap may also emerge as a result of not being exposed to the subject outside of the classroom.



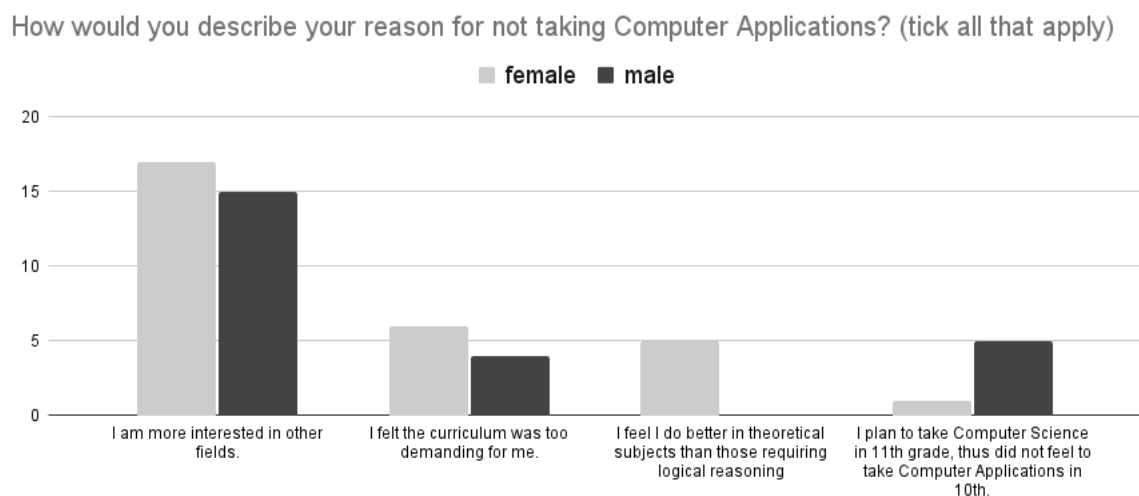
**Figure 5.** Survey results of students studying Computer Applications/Computer Science in grades 9th and 11th, when asked “How confident are you with respect to your coding skills?”

### Gender Stereotyping

The gender gap also stems from the “Stereotype Threat”. The stereotype threat hypothesis suggests performance in a specific is disrupted by the negative stereotypes prevalent (Spencer et al., 1999). Female students are slightly biased towards theoretical subjects, as these fields are not male-dominated and thus they do not face stereotype threats. As shown in the survey results below, male students are slightly more likely to show interest in subjects that are assumed to require logical abilities. The exposure provided and the socially accepted interests and behavior of women encourage gender differences (Eddleston et al., 2006). These gender roles are picked up by children as early as kindergarten and continue to have a long-term effect on their choices as they strive to fit in (Martin & Ruble, 2004). Women prefer careers that offer them more artistic freedom while men lean towards occupations with requirements of high analytical and numerical skills (Gadassi & Gati, 2009). Behavior expectation is also different when it comes to boys and girls. In a social experiment in which a grade 1st was being observed, it was shown that the teacher is likely to praise the boys more and also give them a harsher critique on an incorrect answer, compared to their female counterparts (Brophy et al., 1970)



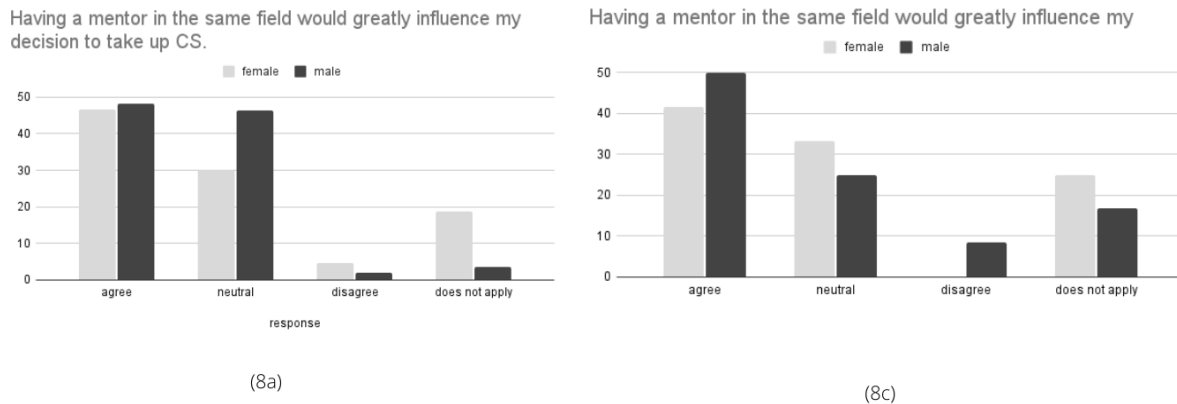
**Figure 6.** Survey results of students of grades 8th when asked “How would you describe yourself?”



**Figure 7.** Survey results of students of grades 9th when asked “How would you describe your reason for not taking Computer Applications?”

### Exposure to the field

Female students lack a female icon with which they can associate (*Women in Computer Science: Getting Involved in STEM*, 2022). This results in not only the promotion of STEM as a male-dominated field but also makes encouraging young girls to explore the field an arduous task. The presence of a role model plays an important role in the construction of a professional identity (Adejare, 2018). Mentors provide support in various aspects, such as advice, exposure, challenges, opportunities, etc. (Kram, 1985). Thus, having a role model or a mentor is important for any individual to develop and sustain an interest in any particular field.

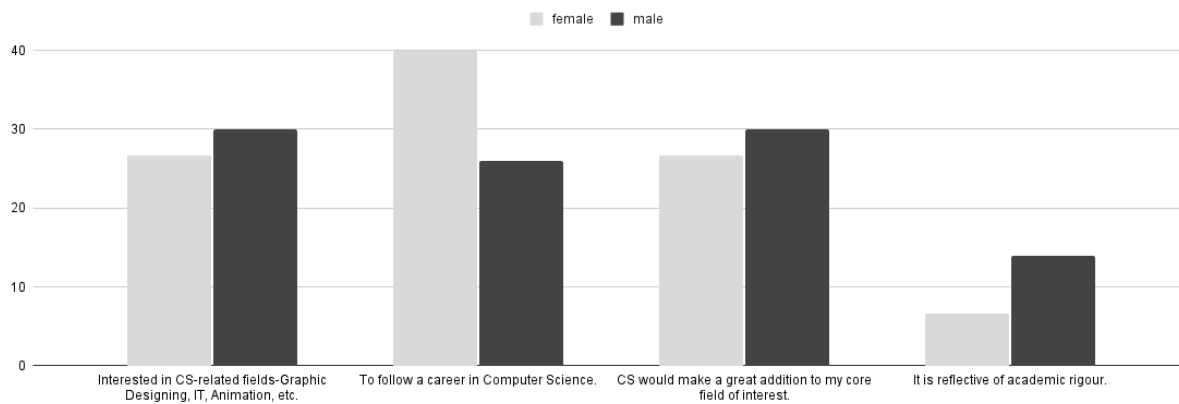


**Figure 8.** Survey results of students when asked, “How do you feel about the following statements? [Having a mentor in the same field would greatly influence my decision to take up CS.]”. (8a) students in grade 9 not studying Computer Applications and (8b) students in grade 9 and 11 who have opted for Computer Applications/Computer Science

### The difference in attitude towards Computer Science

There was no significant difference found between the responses of girls and boys when asked whether they feel they had to put in extra effort to showcase their interest in Computer Science or their performance with respect to their classmates mattered to them. However, there were slight discrepancies found in the reason to take up Computer Science. Female students take up the subject majorly because of their want to pursue it as a career, while male strata’s interest seemed more dispersed.

What would your reason to take CS be defined as? (tick all that apply)



**Figure 9.** Survey results of students studying Computer Applications/Computer Science in grades 9th and 11th, when asked “How confident are you with respect to your coding skills?”

## Results

The data in the graphs shown was collected in a high school located in Chandigarh, India. The data collection was in the form of anonymous surveys, both handouts based and through Google Forms. The survey was made mandatory for all Computer Applications/Computer Science students.

The phases of data collection:

- Data from the previous years:

Year	Grade	Number of Girls	Number of Boys
2018-2019	9	14	14
	10	6	10
	11	1	2
	12	3	8
2019-2020	9	14	13
	10	12	14
	11	4	5
	12	1	2
2020-2021	9	11	21
	10	14	11
	11	2	6

	12	4	5
2021-2022	9	9	28
	10	13	19
	11	6	12
	12	4	4

- Data from surveys taken from

Category	Number of Girls	Number of Boys	Total Responses
Students of Grade 8, who study Computer Applications as a compulsory subject	43	54	97
Students of Grade 9, who have opted out of Computer Applications and have taken either Physical Education, Economics or Art as their elective.	40	39	79
Students of Grade 9 and 11, who have taken Computer Applications (Grade 9) and Computer Science (Grade 11)	10	29	39

## Conclusion

To conclude the matter, it is important to realize the severity of damage this gap can bring if left unabridged. Definite measures need to be taken to make women feel comfortable about taking up Computer Science as a career or even just as an interest. It is important for the professionals in STEM and in education to revisit the strategies followed to promote Computer Science. Lastly, the destigmatization of women in Computer Science needs to be thorough to prevent any the formation of any negative stereotypes.

## Limitations

The surveys conducted were limited to one privileged high school based in Chandigarh, India. There were a limited number of students in Computer Science and Computer Application classes. The setting of the study was in Chandigarh, where literacy regarding the subject is much higher in comparison to most cities.

## Acknowledgements



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