"I Can Do That Too": Factors Influencing a Sense of Belonging for Females in Computer Science Classrooms

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ABSTRACT

Previous research on belonging in computer science offers insights into the role that stereotypes play in reducing females' sense of belonging or fit in computer science (CS), which has been associated with their significant underrepresentation in the field. Drawing upon mixed methods (surveys and interviews), this study explores the quantitative variables associated with a sense of belonging for females in high school CS courses and provides qualitative insights from students to help explain why these factors matter. Pre/post survey analysis indicates that the courses are contributing to reducing pre-course gender gaps in students' perceived efficacy and belonging in a CS classroom. The surveys also suggest that females were more engaged and developed stronger relationships with teachers. And yet, females' commitments to continuing with CS had no sta-tistically significant changes. Student interviews provide important context regarding the quantitative findings and describe how pos-itive relationships with a female teacher, collaborative work and inclusive teaching practices played key roles in promoting a class-room sense of belonging for females. Overall, these results suggest that an academically engaging and socioemotionally supportive experience in a computer science course can reduce gender gaps and foster females' sense of belonging in the classroom even if they retain some reservations over their long-term fit in the field. The findings contribute to a more nuanced understanding of the factors that promote equitable experiences for females in CS and the relationship between classroom level belonging and long-term fit in computer science.

CCS CONCEPTS

• Social and professional topics → K-12 education;

KEYWORDS

Gender, equity, K-12 education, sense of belonging, broadening participation

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1 INTRODUCTION

Despite progress in other STEM fields, women continue to be significantly underrepresented in computer science careers [20]. While K-12 access to computer science has improved, only about half of the high schools in the U.S. offer a computer science course [5]. Of all the students taking a CS course in high school, only 31% are female [5]. High school computer science courses, especially those with a computer programming component, have the potential to narrow the gender gap in the field [17, 30, 31]. However, several factors contribute to lower enrollment rates amongst females. Most notably, stereotypes about computer scientists contribute to females' beliefs that they do not belong or fit in the field of CS [15, 22]. While there is a need to further understand gender disparities in CS course enrollment, there is also a need for additional research to document the types of learning environments that foster equitable outcomes and a sense of belonging for all students, particularly females and underrepresented minority students [10, 19]. This paper presents analysis of quantitative and qualitative input from high school students in computer science courses to explore the impacts of these courses and highlight the factors that promote positive outcomes, particularly for females. The paper focuses on the following questions:

(1) How do student experiences in, and perceptions of, high school computer science courses vary by gender?
(2) What are the factors that influence students' sense of belonging in these courses?

2 PREVIOUS RESEARCH

2.1 Equitable experiences in CS

Fletcher and Warner's CAPE (Capacity, Access, Participation, Experiences) model [10] provides a useful lens for studying the multiple spheres where inequalities exist in the field of computer science. For low-income students and students from underrepresented backgrounds (i.e. Black, Latinx, and American Indian), unequal access to schools that have the capacity to offer these courses is often a key factor in disproportionate participation in CS [5]. For females, stereotypes about who goes into computing play an oversized role in their underrepresentation in computer science courses [15, 22]. For females who do enroll in computer science, many have been put off by male dominated spaces and pedagogy that emphasizes individual work and content that seems decontextualized from real world applications [13, 18].

Promoting equitable experiences for underrepresented students in CS involves a combination of engaging students deeply with the content, fostering supportive interpersonal relationships, and cultivating a welcoming and inclusive environment. Through analysis of extensive observations of Exploring Computer Science courses in high schools, Margolis and colleagues [11, 17] summarized the types of classroom practices that promote engagement and belonging in CS. These include 1) computer science disciplinary practices that focus on problem solving and computational thinking; 2) inquiry approaches that promote active student participation; and 3) equity practices that aim to include and welcome all students through culturally responsive teaching. In higher education, the Computer Science Department at Harvey Mudd College has attracted and retained a high percentage of females by making their introductory courses more engaging, and connecting females with internships and female role models in the field of CS [13]. Changes in the course include using a more accessible programming language, emphasizing real world applications of CS, and fostering a supportive peer culture by discouraging more experienced students from "showing off".

2.2 Student Belonging

Sense of belonging is a useful construct for understanding the experiences of students across grade levels and professional fields, including computer science. A sense of belonging has been associated with positive behavioral, psychological and academic outcomes for students in kindergarten through college [29]. Definitions of a sense of belonging can vary, but a common definition of school belonging for students is "the extent to which they feel personally accepted, respected, included, and supported by others -especially teachers and other adults in the school environment" [12]. This definition emphasizes the importance of interpersonal connections, feeling included and mattering to others in a school community [29]. For instance, when students feel that their teachers care about them and encourage their participation in the classroom, or when students have positive interactions and feel supported by peers in their classroom, they are more likely to feel a sense of school belonging [29].

In computer science education research, a sense of belonging tends to focus on an individual's assessment of the fit between how they see themselves and their image of people in the field of computer science [15]. In this work, a sense of belonging is influenced by an individual's assessment of their ability to do computer science (the eficacy component of belonging) as well their belief that people like them go into computer science (the fit component of belonging) [14–16]. This research helps us understand how stereotypes about computer scientists contribute to lower rates of female participation in the field. For instance, stereotypes about ability (i.e. females are less able to do computer science) and the characteristics of computer programmers (e.g. "nerdy", obsessed by programming) lead many females to assess that computer science is not a future career that fits their own identity [3, 4, 18, 28]. In addition, the stereotype that females are less interested in computer science can send females the message that they don't belong and suppresses an interest to take an introductory course or to pursue a major in the field [22]. And even when females take a course and show interest and engagement, perceptions that people like them do not go into computing, or are not welcome in the field, diminish their interest in continuing with future courses [27]. Computer science education research would benefit from further exploration of the interplay between belonging at the classroom level and a sense of belonging or fit with the field of computer science that is shaped by stereotypes at the structural level. In particular, studies that center on the perspectives of students in these courses can be instrumental in shaping equitable experiences for students, and providing greater insights into the factors that shape belonging for students [27].

3 METHODS

3.1 Research Context and Design

This research was conducted as part of a larger three year NSF funded CSforAll project[1] to expand access to and broaden participation in high school CS classes. Working with 23 high schools in a research practice partnership [26], faculty from a liberal arts college provided comprehensive training and support for in-service teachers certified in other subjects to help them start new CS classes at their schools [9]. Of the 27 participating teachers, 16 had never taught a CS course and 19 had little or no formal CS background.

Support for teachers included complete curricula and professional development (PD) for two CS courses - a high school level course (Discovering CS) and a college level dual-enrollment course (CSIS110 Introduction to CS with Python and Multimedia) [9]. Both courses are broad introductions to CS, covering concepts, societal impacts, and coding that allows students to express their creativity and individuality using images, sounds, and animations. In addition to CS course content and pedagogy, the PD addressed broadening participation in the CS field and equity promoting practices in the classroom [9].

This study followed a mixed methods convergent design procedure with the intent to compare the quantitative and qualitative data and provide a more complete understanding of an issue [7]. In this design, the two types of data can validate each other and provide a more nuanced understanding of a phenomenon. With this approach initial data collection (step 1) and analysis (step 2) were done separately, and then the data was merged (step 3) and analyzed collectively (step 4) [7].

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3.2 Quantitative Data Analysis & Collection

In each of the three years of the project, students enrolled in the Discovering CS or the CSIS110 course completed anonymous surveys at the beginning and end of the school year. A goal was to measure changes in student perceptions, so the pre- and post-course surveys contained a common set of questions asking students to rate their level of agreement with statements about their CS abilities/knowledge, sense of belonging, and future plans. In addition, the post-survey asked students to rate their level of agreement with statements about their CS class and teacher, with several of these questions addressing students' sense of belonging in the classroom and their relationship with the CS teacher. All questions used a 1 to 5 Likert scale, where 1 is strongly disagree and 5 is strongly agree. For face validity and consistency, only minor changes for clarity and alignment to current project goals were made to the survey instrument [8] used for prior projects. For this paper, analyses are based on a sample of students whose pre- and post-surveys could be matched using their responses to five identifier questions selected to have stable answers over time (e.g., third letter of their first name). This matched sample is used to ensure consistency in which students' responses are used in analyses across the pre- and post-course items and to allow comparisons of individual changes across time.

There were 551 matched surveys, with 25% of the students self-identifying as female and 75% self-identifying as male on the surveys (other gender categories offered were too small to include). This is consistent with the demographics of the classes as reported by the high schools. Although female students were underrepresented in the CS classes, we observe that the CS teachers were predominantly female (70%). In terms of course enrollment, 51% of the surveys were from Discovering CS students and 49% were from CSIS110 students. Participating schools were diverse and included three urban, eight suburban, and twelve small rural schools. The three urban schools and four of the rural schools were high-needs, where high-needs is defined as having 50% or more economically disadvantaged students as reported by the NYS Education Department [25].

In a statistical analysis of the survey data, we used two approaches to compare mean responses. Comparisons between male and female students were tested using two-sample t-tests to examine average differences between groups. Comparisons of responses between the pre- and post-course surveys were tested using paired-sample t-tests that examine average changes in students' responses over time. Both comparisons between groups and individuals over time use responses from the same sample of students. Through analysis, belonging arose as a core theme and construct with student experiences varying by gender.

3.3 Qualitative Data Analysis & Collection

Thirty-four high school students in the Discovering CS or the CSIS110 course were interviewed, most twice, for a total of 61 interviews. The students were from three different schools in New York State, from five different classrooms, all with female teachers. Reflective of the gender and racial imbalances in these courses, there were twenty-nine males and five females in the sample (29 White, 5 Black and/or Latinx). The open-ended semi-structured interviews were conducted through Google Meet, and lasted between 15-30 minutes, with an average length of about 20 minutes.

In the collection and analysis of data, a phenomenological approach was used to focus on students' accounts of their lived experiences in computer science courses [6]. Interviews were transcribed and coded using MaxQDA qualitative analysis software to identify statements that explain the interviewees' experiences and themes to understand the larger phenomenon [6]. As the data were analyzed, clear differences emerged in student experiences by gender. In particular, relationships, course instructional practices and content mattered more to female sense of belonging in their courses than males.

4 RESULTS

4.1 Quantitative Survey Findings

The survey data illuminated statistically significant differences between female and male computer science students. Findings indicate that females had lower levels of self-perceived eficacy, belonging, and future commitments to computer science than males at the start of the computer science classes. Yet, students' responses after taking the class indicate stronger engagement, classroom belonging, and teacher-student relationships for females compared to males. These data suggest that females had better experiences in computer science than their male peers, and in fact the differences between genders were reduced over the duration of the course. Table 1 shows survey questions related to eficacy, belonging and future interest in CS and the students' mean responses by gender on the pre- and the post-survey. Eight of these questions had statistically significantly ($p<.05$) lower means for females than for males on the pre-survey, while only two were significantly lower on the post-survey.

4.1.1 Engagement. There is evidence that all students were very engaged in the courses. However, as shown in Table 2, females responded significantly more positively than males ($p<.05$) to post-survey questions regarding class interest and overall satisfaction with their experience in the course. In addition, over the three years of the project, the average female grade in these courses was 85% compared to 81% for non-female students. These self-reported student perceptions combined with academic course outcomes provide evidence that the average female engagement level was stronger than their male peers. Given that high levels of engagement and achievement have been associated with a higher sense of belonging for females [12] this supports the conclusion that females felt a sense of belonging in these courses.

4.1.2 Relationships. Post-survey responses suggest females were very satisfied with their relationships with their teachers in these courses, which is also correlated with a sense of belonging at the classroom level (see Table 2). While both females and males tended to strongly agree with these statements, there were highly significant differences ($p<.001$) between the mean responses for females and males. Females were more likely to say that their "opinions were valued in this class", the teacher "encouraged my participation" and the teacher "displayed an interest in student learning". Moreover, females were more likely to agree that their teachers "made them feel welcomed in this class" ($p<.05$). This is an admirable

Table 1: Pre- and post-survey mean responses and changes by gender.

Asterisks indicate statistical significance: * is p < 0.05; ** is p < 0.01; *** is p < 0.001.

Statement	Female pre	Male pre	Female post	Male post	Female change	Male change
I am a sophisticated computer user.	3.40*	3.65	3.61*	3.79	0.207*	0.147**
I am able to solve basic problems through computer programming.	2.90*	3.13	3.93	3.95	1.036***	0.815***
I can explain what computer science is to my friends.	3.28*	3.49	4.01	3.99	0.728***	0.502***
I have a basic understanding of the discipline of computer science.	3.38*	3.59	3.96	4.00	0.574***	0.413***
I know a lot of students like me who are interested in CS.	3.07*	3.27	3.01*	3.41	-0.051	0.144*
I have role models in computer science who are women.	2.82	2.78	3.10	2.96	0.270*	0.182**
I feel I am a part of a community of students who are interested in CS.	3.11*	3.34	3.35	3.42	0.234*	0.084
I am considering a career path in computer science.	3.19*	3.64	3.21	3.42	0.036	-0.203***
I am considering a college major related to computer science.	3.16*	3.50	3.20	3.33	0.044	-0.167**
I am considering taking additional courses in computer science.	3.60	3.71	3.57	3.68	-0.007	-0.012

Table 2: Post-survey mean responses by gender.

statistical significance: * is p<0.05; ** is p<0.01; *** is p<0.001.

Statement	Female	Male
I found this class ...		
to be interesting.	4.30*	4.12
to be challenging.	3.88**	3.58
increased my interest in CS.	3.93	3.85
In this class...		
I felt my opinions were valued.	4.24***	3.94
I was satisfied overall with my experience.	4.35*	4.18
The teacher for this class...		
displayed an interest in student learning.	4.62***	4.38
encouraged my participation.	4.62***	4.38
made me feel welcomed.	4.66*	4.49

accomplishment since many were in courses where females were a small minority. Given that the definition of a school sense of belonging involves being valued and included in a school space [29], this data provides additional evidence that the females tended to have a sense of belonging in their CS classrooms.

4.1.3 Efficacy. The survey data shows many impacts on students' perceptions of efficacy in computing, with evidence that the course reduced female and male gender gaps for this variable. For instance, there were significant (p<.05) to highly significant (p<.001) positive changes from the pre- to post-survey in both female and male mean responses regarding efficacy (See Table 1, first four questions). On the pre-course survey, the mean female response was significantly lower (p<.05) than the mean male response to these four questions. However, on the post-course survey only the response to "I am a sophisticated computer user" continued to show a significant difference between females and males (p<.05). Overall, the mean female responses tended to show more growth from the pre- to post-survey, but males maintained higher post-survey assessments.

4.1.4 Sense of Belonging. Female responses to questions associated with a sense of belonging point to some of the challenges for females in developing a sense of fit to the field of computer science. Mean responses for this set of items were somewhat lower than the other survey questions for both females and males. The statement "I have role models in computer science who are women" had the second lowest pre-survey mean of all items on the survey. Nevertheless, the post-survey showed statistically significant growth for both females (p<.05) and males (p<.01) on this item (see Table 1), suggesting that the course facilitated learning about female role models. Male responses showed significant pre- to post-survey growth (p<.05) on the statement, "I know a lot of students like me who are interested in CS", but females did not. For this item, significant differences between genders found before the course (p<.05) persisted after the course. This is likely influenced by the fact that most of the courses had predominantly male students and females often had few female peers in the course. However, females' mean responses showed significant positive change from pre- to post-survey regarding feeling "a part of a community of students who are interested in computer science" (p<.05). Furthermore, the statistically significant difference between genders on this item in the pre-survey (p<.05) was not found on the post-survey. It is likely that females recognized that there are not a lot of people "like them" in their computer science classrooms or the field, but they still felt part of the classroom community at the end of the year, due in part to the strong engagement, relationships, and feelings of efficacy documented above. It may be that the courses are fostering a sense of belonging for the females at the classroom level, however, not seeing people like them in their courses may reinforce gender stereotypes about who is interested in CS and suppress their sense of belonging or fit in the field [22] .

4.1.5 Future plans in CS. There was no significant change in females' interest in continuing with computer science in the future (see Table 1, last three questions). While males were significantly more likely than females (p<.05) to consider a career path or major related to computer science in the pre-survey, there was no statistically significant difference between genders in the post-survey. The closing of the gender gaps were due to statistically significant declines in mean male responses (p<.001 for careers and p<.01 for majors) while females mean responses remained relatively constant. While not the focus of this paper, these results are concerning, and

the factors impacting future plans for both males and females in CS need further analysis.

4.2 Qualitative Interview Findings

Course level factors such as caring teachers, collaboration, and an assignment to research underrepresented computer scientists helped to promote positive experiences and a sense of belonging in the course for female students despite classrooms that were overwhelmingly male. Males tended to see the same factors as mildly positive or neutral.

4.2.1 Gender, Belonging and Relationships. For females, belonging in the course was more likely to be related to interpersonal dynamics, while males' level of comfort and belonging were almost always associated with the degree to which they felt they were mastering the course content. While females also talked about course content, the impacts of being a gender minority were more prominent. For instance, two female students talked about the anxiety associated with people looking at them and judging their physical appearance. One female student, Imani [2], preferred learning online for this reason. Jill shared that walking into a class of all males was intimidating and made her consider dropping the course. These uncomfortable interpersonal factors may be a reason for females' lower sense of belonging compared to males in computer science courses, but further study is needed to examine this relationship [23].

Quality relationships with their female CS teachers were key to female students' sense of belonging. When asked to talk about their teachers, males tended to describe teaching practices and the females were more likely to also talk about their relationships with their teachers. For Jill, having a female teacher who cared about her made a key difference in her confidence and comfort. She said, it "showed me that women can do this." And she added, "if it was a male teacher, I would have dropped it...I would have been so uncomfortable." Jill stayed with the course because the teacher was "so understanding and helpful" and she said she was planning to take the next course because "I know she is teaching next year." These comments suggest that a caring female teacher can serve as a powerful role model and positively impact females' confidence and persistence in CS, which are key components of belonging.

While most students were generally positive about collaborative work, males tended to emphasize how it helped them to solve problems, and females also talked about how it played a role in their belonging in the course and the field of CS. For instance, females talked about how positive collaborative work and interpersonal relationships in the course influenced their comfort and engagement in the classroom. Jill shared that the collaborative work at the start of the year brought her anxiety because she was initially hesitant to ask males questions because she was worried they would assume she was "hitting on them." Eventually, she found "one friend [to work with] ...and that help[ed]." Her teacher allowed her to stay with this partner for multiple projects and that was a key factor in her comfort level and decision to stay in the course. In addition, the emphasis on collaborative work led a few females to consider a future in computing. Anna, who was now "thinking about majoring in it" explained, "I thought a lot of it would be done by yourself and you just have to problem solve everything. But after being in the course, it's a lot of talking to others." This supports the argument that a greater understanding of careers in CS may promote more interest in the field for females [30].

4.2.2 Equity-Minded Instruction. An assignment that required students to research computer scientists from underrepresented backgrounds had a significant and positive impact on the female students in the courses, helping them to persist and imagine themselves as future computer scientists. Imani researched the contributions of an important female in the history of computer science and shared that this female talked about her own previous self-doubts before her breakthrough in the field. Learning about this female figure in computing "inspired" Imani. She said: "Now, as a female student, I see there's a lot of women in that kind of situation. It pushes me to think, 'I can do that too if they did that.'" For Jill, learning about the struggles of another woman made her feel less alone as she tried to feel a sense of belonging in a course full of boys. She said: "I picked an African American woman and how she was different and how she felt she wasn't smart enough. And it was the same situation as me because it was like, all the guys against the girl... But I feel like it was good to connect to somebody... it was like, 'oh okay, you felt alone because that's how I feel.'

The assignments and discussions around diversity seemed to be more important to the females interviewed. They often brought up these topics before they were asked about them. And these activities changed how some females saw themselves and their capacity to do computer science. For males, they generally either saw the activities as interesting, important to know about, or a bit tangential to the core programming of the course.

4.2.3 Factors Influencing Field Belonging in CS. Before taking a CS course, none of the females interviewed were seriously thinking about a career in CS, and three were a bit unsure about enrolling in the course. After the course, all of them felt confident about their computing abilities and all were at least considering computer science as a career pathway. The teaching, the teachers, and the curriculum were all important factors in helping these females engage with CS and feel like they belong in the course and the field.

Despite positive experiences in their CS courses, females' long-term commitments to CS were less certain and contingent on multiple factors, whereas males' commitments to CS tended to be stronger and based primarily on their interest in coding. These future factors were similar to the factors that influenced females belonging in the course, such as concerns over gender equity, interpersonal dynamics in the workforce, and social applications of CS. Consistent with other research, a few females' commitments to CS were tempered by expected inequalities in the field. Laura anticipated experiencing gender bias when she said "people will look down on me" and it was something she would have to "suck up and deal with." Anna had some concerns that being outnumbered by males in a college course might be less comfortable than her recent experience in high school. However, both Laura and Jill also talked positively about job prospects for females in computing and the potential to use CS in various ways across fields, suggesting that the course's efforts to inform students about CS careers were paying dividends.

[2] All names are pseudonyms.

5 DISCUSSION

Females and males in the study both reported positive experiences in their high school computer science courses. Females reported higher mean satisfaction and growth on several measures, reducing many of the pre-survey gender gaps by the end of the course. For instance, eight pre-survey questions showed statistically significant gender gaps in eficacy, sense of belonging, and future commitments to CS. By the post-survey, differences in only the two statements about being "a sophisticated computer user" and knowing "students like me" in CS remained statistically significant. Several factors, including quality relationships with teachers, collaborative work environments, and equity-minded curriculum contributed to females' sense of belonging in the courses. Based on the quantitative data alone, this classroom level belonging did not translate into a statistically significant increase in females' interest in pursuing a future in computer science. However, the interviews with females suggest that the course did increase their interest in the field, just with reservations.

As documented in previous research [18, 28], this study also found that relationships and belonging mattered more to females than males. In this study, females reported higher quality relationships with their teachers than males and their perceptions of having female role models in CS increased significantly from the pre- to post-survey. Given that 70% of the teachers in this project were female, this may have been a factor driving both the increase in role models and the quality relationships for females in the courses. Additional analysis is needed to explore that relationship in the quantitative data. However, the interviews pointed to the key influence of female teachers on their female students. Moreover, female role models are linked to persistence in CS [13], and they may be especially important to bolster female confidence and counter situations when stereotype threat could be triggered [21]. In addition, the qualitative interviews provide evidence that a diversity project helped females discover female role models in the field who served as inspiration for their success in computer science. Lastly, the collaborative work fostered both a sense of belonging to the classroom and the field of computer science.

Female eficacy levels increased between the pre- and post-surveys and the gender gap decreased. This significant growth in eficacy for females suggests that the course helped to remove a barrier – low self-confidence in computer science- that is associated with lower sense of belonging in the field [14, 18]. However, the statement about being a "sophisticated computer user" continued to show a significant gender difference at the end of the study. This could be because males had more previous experience with computing before the course, which qualitative data and previous research supports. It could also be due to males' inflated perception of abilities and the tendency for females to under assess their skills in STEM fields [18]. However, the fact that females earned higher average grades than males in these courses provides a powerful counternarrative to false stereotype about females' abilities in CS.

Despite positive course experiences that fostered a classroom level belonging, there was no significant change to females' future interest in computer science, at least in the quantitative data. However, the qualitative data showed that females' confidence and interest regarding future pathways in CS grew through the course. The interviews also highlighted how females were thinking about their possible futures in CS in complex ways and weighing several factors - work environment, impacts of the work, benefits, and other viable career options - before committing to any career. This suggests that the course curriculum was helping the students make more informed decisions about their careers. In addition, this positive pre-college experience may make it more likely for these females to retain a sense of belonging and self-eficacy in computer science when in college, even if the environment is less welcoming [24].

This study is not without its limitations. While the mixed methods design is a strength of the study, the sample for the qualitative component would have been stronger if there were more interviews with females. The interviews provide an important foil for the surveys, but they are not generalizable. In future analysis of the study data, it would be informative to also explore how factors like belonging, eficacy, and commitments to CS may differ by the kind of school, course type, and student level characteristics (race, class, and previous academic record). For instance, additional intersectional analysis is needed to explore how student characteristics influence variables like belonging and future commitments to CS while controlling for gender. In addition, the use of established scales to measure sense of belonging in the field of computer science and in K-12 schools would be helpful to further explore the relationship between these two constructs.

6 CONCLUSION

This mixed methods study highlights that students' experiences in high school computer science differ by gender. Females began with lower levels of self-perceived eficacy, belonging, and future commitments to computer science than males. Yet, after taking the class, females indicated stronger engagement, classroom belonging, and teacher-student relationships than males. Differences between genders lessened over the duration of the course, indicating that females had better experiences in computer science than their male peers. A significant portion of previous research on belonging in computer science is quantitative and offers key insights into the role that stereotypes play in reducing females' sense of fit or belonging [22]. Others have pointed to the importance of collaboration, relationships and relevant content to promote a sense of belonging [1, 2, 13, 15]. This study illuminates factors that fostered a sense of belonging in the classroom and a nascent sense of belonging to the field for females. This includes classroom practices and characteristics that build confidence, comfort, interest, and belonging in computer science for females, even when they are significantly underrepresented in a classroom. The results suggest that educators should consider inclusive content, interpersonal dynamics, and access to caring role models in order to foster equitable environments. Furthermore, they suggest that a quality experience in an introductory computer science course in high school can foster females' sense of belonging in computer science, even if they retain some reservations over their long-term fit in the field. Going forward, it may be helpful to expand the definition of sense of belonging in computer science to include a classroom level component in addition to a field level of belonging in order to investigate the relationship between these two aspects of belonging.

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