Fostering a Sense of Belonging in Female Computer Science Students*

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Abstract

Female students are underrepresented in Computer Science degree programs at US colleges. This problem has resisted interventions for decades and average enrollment rates are stubbornly hovering around 18%, several success stories at selected institutions notwithstanding. Solutions to this problem require bringing in more female students and once enrolled keeping them in the program. To achieve the latter, improvements have been attempted at the curricular and pedagogical level on one hand, and on the social and community building level on the other. This paper describes a low cost approach to building a sense of community and belonging by making a Women in Computing club more "official" using a "token of belonging." Membership is made more rewarding by the promise of a conference trip

1 Introduction

The Computer Science Department at NJIT has been part of the BRAID multi-university consortium of 17 institutions with the declared goal of increasing the representation of women in Computer Science degree programs. (Regrettably,

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BRAID was sunsetted on May 18, 2021.) The consortium defined a multi-pronged approach dealing with curricular and pedagogic issues on one hand, and with community building, social capital creation, and fostering a sense of belonging on the other hand. A good method for community building and creating a safe space for female students is the establishment of a club specifically designated for them. This was achieved early on in the project, and the local Women in Computing Society was strengthened by "cross-listing it" with an ACM-W chapter. Thus members of the local club were encouraged to sign up for the ACM-W chapter, and officers of the local club served as president and vice-president for the national ACM-W club chapter.

Famous female, out-of-town guest-speakers as well as presenters from our own university were invited and hosted by the Women in Computing Society. Before the COVID pandemic changed the realities of education, guest speaker engagements were always combined with pizza parties. Yet we observed a wide range of "reactions" to the club and the club activities. A small core of female students became heavily involved, volunteering to serve as club officers and at club events. A larger group of female students ignored club activities. Random sampling of female students "in hallways and elevators" uncovered that some of them did not know that the Women in Computing Society exists. This happened at a time when a guest speaker of the club was widely announced by bulk email messages and by posters on the wall of the CS building.

In this paper, we address the two issues of female students not seeing intrinsic value in being club members, while apparently not gaining a stronger sense of community when they join the Women in Computing Society. We suggest a preliminary attempt at improving this state of affairs: A "token of belonging" tied to club benefits, especially attendance at a conference.

2   Background

Academic success of female students in Computer Science cannot be achieved by improved pedagogy and curriculum manipulations alone, as long as the environment is not welcoming. A key factor for achieving persistence (retention) as a student is a sense of cultural and social belonging [6, 7, 2]. Feelings of belonging can be engendered by creating a community [10]. This has been investigated, for example, in the wider context of validation theory [8]. An important source of feelings of belonging is the validation provided by peers [1, 12]. Another source of a sense of belonging documented in the literature is the validation by faculty members and even by office staff [9]. The beneficial effect of a sense of belonging does not start in college and is not limited to gender-defined groups. Ethnic groups in high school are equally in need of it, even though differences have been observed between groups [4]. The need for

community building has been established in many studies in different contexts.

Practical advice on how to create a sense of belonging is harder to come by, especially when teachers are hurried and peers are themselves lacking a community that they feel they are a part of. An award-winning teacher [3] recommends five practical approaches:

- Shine a light on each student.
- Foster student identity building.
- Always leave one desk empty.
- Make sure that each child feels chosen.
- Weave social and emotional practices throughout the day.

Unfortunately, except for the "empty desk," which is intended for welcoming a student who might join the class later in the semester, none of these "practical" recommendations is prescriptive enough to inform an instructor in the classroom what to do, without providing further elaboration.

In a wide variety of organizations where a sense of belonging is essential for cohesion and functioning, "physical signs" are used to create a specific member identity. The use of uniforms for soldiers, firemen, etc. is a good example, but uniforms also appear in educational institutions [11]. Some expensive private schools require students to wear school uniforms even today. Richard Feynman describes that he had to wear a gown for dinner every night when he was a student at Princeton University [5].

The "physicality" of the visible signs of belonging inspired us to look for a "token of belonging" that could be used to strengthen the feeling of membership in our female students, connecting them to their peers.

At special college events, T-shirts are often given out to organizing committee members, creating a uniform. Everybody wearing the T-shirts "is an insider." For example, at the International Collegiate Programming Competition (ICPC), T-shirts in two colors are handed out (Figure 1), one color for staff members and a different color for competing participants. This creates a hierarchy and two "levels of belonging." However, the purpose of such "uniforms" is identification as opposed to achieving a feeling of belonging. Such T-shirts are rarely worn outside of the events where they are required. Thus, T-shirts were not a solution for us.

3   Methods

Working since 2015 with student members of a college-level Women in Computing Society, several observations were made about subgroups of students, reflecting different attitudes toward the club. We will distinguish between the local club and the ACM-W chapter, as they bring out different reactions from

Figure 1: ICPC T-Shirts for Staff (left) and for three Participants.

the students. One difference between these two organizations is that our local club does not charge the students a membership fee, while the ACM-W is an international organization that, at the time of this writing, charges an annual fee of $19. The second difference is that the ACM-W requires students to sign up on the ACM website. For the local club no such requirement exists. Little can be said about the group of students that is potentially the largest, the "silent majority." We have to focus on students who speak up. Two major groups emerged.

- Subgroup 1: This group can be characterized by the question "Why should I join"? Members of this group of students do not think that community in itself is of any value to them. They do not see any advantages in fostering a closer connection with like-minded students in the local club. They are also not impressed by belonging to a world-spanning organization such as the ACM. They don't see any value in discounts for conference registration fees and academic publications for ACM mem-

bers, as they have no conception that these would become valuable at a later stage in their education and career. Neither do they understand that advanced levels of membership can only be achieved after being a "basic member" for a few years and that "advanced memberships" (e.g., senior member or fellow) can be included in their resumes and increase their marketability. Finally, some students were reluctant to pay the ACM membership fee. To encourage such students to become members of the ACM-W, grant money was made available to cover the $19 membership fees for them. Yet the simple tasks of clicking on a registration link and entering basic personal information seemed prohibitive for at least some of the students, who did not sign up after repeated email reminders.

- Subgroup 2: "How do I become a member of the NJIT Women in Computing club"? We used to tell students of this group that there was nothing they had to do. They were women, and they were Computer Science students. By dint of these two facts, they were automatically members of the club. They should just attend the programs and events of the club, without any limitations. The impression we received from this group was that "it was too easy." Members of this subgroup did not ask "why become a member" and appeared to understand the advantages of belonging to a community on an instinctive level. They were not bothered by the same issues as Subgroup 1. Rather they wanted "evidence" that they were members.

Thus, we wanted to find a method that was more concrete than "Make sure that each child feels chosen" (Bullet 4 in Section 2) and that gave the students of Subgroup 2 "proof" that they were members, but that did not impose obstacles, such as the effort of filling out a membership form, on the students of Subgroup 1. Furthermore, we needed to give Subgroup 1 a good reason why they should want to be members, at least in the local club, if not in the ACM-W chapter.

We had one powerful incentive at our disposal. Over the last few years, we have sponsored trips to the Grace Hopper Celebration/Conference for groups of our female students. Registration fees, hotel rooms, and airline tickets were all paid for, for close to 20 students each year. In 2020, when the Grace Hopper Conference was held as a virtual event, we were able to pay the registration fee for 50 of them. Once word got around that this opportunity existed, the demand for "tickets" exceeded the 50 that we had available, and students who were left out started asking about "next year" (2021).

As a result, these are the methods that we are using this year to increase interest and participation in the Women in Computing Club. Working through the eBoard (the officers of the club) we spread the "rumor" that only members of the club would be eligible for free registration at Grace Hopper, which is

Figure 2: ID Card Sample for the Women in Computing club.

virtual again in 2021. This was intended to address the thinking of Subgroup 1 of students who felt they did not need to belong to the club, because it did not provide any obvious benefits.

To satisfy the need of Subgroup 2 to have "proof" that they are members of the club, without imposing the need to fill out a signup form (which would have discouraged Subgroup 1), we introduced an ID Card for members. All students had to do was to inform their eBoard officers that they wanted an ID. The eBoard provided us with a list of names and email addresses and we ordered the cards for them.

The logo on the card had been created by previous club members, who had graduated several years earlier, for use on flyers and posters of the club.

We offered the current eBoard the chance to either design a new logo or to organize a competition among the members for designing a new logo, however, the president of the club declared herself satisfied by the existing logo combining a power button, the biological symbol for females, and a C++ style multi-line comment with the symbols /* and */ with the name of the club between them (Figure 2). Cards are of the same shape and size as our college ID cards and can be worn hanging on a lanyard or chain.

To alleviate the concerns of the Campus Police Department (that we consulted) that the cards could be used as fraudulent identification, we made it a point not to include the name of the university on the cards. Figure 2 shows an example card, with the student name partially obscured for privacy reasons.

After the cards were printed, we sent email messages to all the students that due to COVID-19 we would not come to campus, but if they provided us with their home addresses we would be happy to mail them the IDs.

4   Results

A total of 39 students requested ID cards. It was encouraging for us to see that three of those students, who missed the original deadline, later wrote in a "desperate tone" that they really wanted one. We accommodated them, and we had clearly created interest in this "token of belonging."

As a side remark, we also found it encouraging that the commercial company printing the ID cards requested a signed letter from the university to verify that our order was legitimate. After we pointed out that the university name does not appear on the card, they settled for a letter from the Dean of the College. This encouraged us to put the name of the college on the card.

When we requested the students' home addresses, 32 students responded on short notice. (Most others followed soon after.) We speculate that had we asked for their home addresses at the beginning of the process, this would have deterred some of them from asking for a card, but once we had a good reason (COVID and mailing), students were forthcoming with the information. In the process we discovered that one of the students was in India and we decided not to send the card to her.

Our students are already "over-questionnaired" and we did not want to impose yet another survey on them. On the other hand, we wanted to get minimal feedback to see how much they cared about their new IDs. For this purpose, we sent an email message with a single question to them, and we made it a point NOT to send a follow-up message to students who did not respond the first time. Only students who cared enough to respond to the first message were of interest to us. We received 16 responses, most of them within a few hours of sending the question.
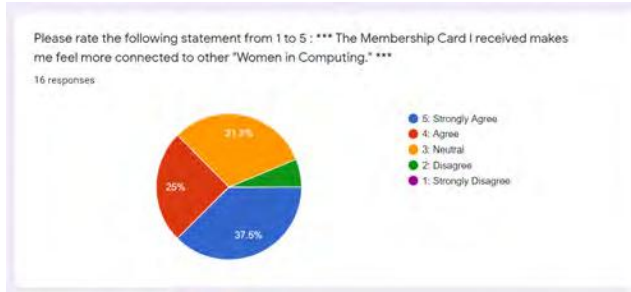
Figure 3: Responses of 16 of the card recipients.

As Figure 3 shows, 62.5% of the respondents stated that they agreed or strongly agreed that the membership card made them feel more connected with "Women in Computing." Not a single student disagreed strongly with the statement, and 31.3% felt neutral about it. One student (6.2%) disagreed with the statement.

5   Discussion

We presented a preliminary study concerning the advantages of a "token of belonging" to a club for Women in Computing. In a year when no pizza parties could be held and all guest speakers of the Women in Computing Society gave their presentations on Zoom or WebEx, a physical connection appeared especially important. We intend to repeat the ID Card provisioning at the beginning of future semesters, as long as there is a budget available for it. We will actively involve the incoming eBoard of the club at the beginning of the fall semester and discuss variant ideas, e.g., creating cards in two different colors to distinguish high-achieving students or eBoard members.

Much of this work was informed by anecdotal evidence. In the future, we would like to use a questionnaire in a physical setting ("after a pizza party") to get a better understanding of the perceptions of the students and their attitudes towards club membership.

Many students wear the official university ID cards on a lanyard around their necks, to use the swipe card access to locked rooms that these cards provide. Once on-campus activities will be ramped up again, we will be looking out for students who also wear their Women in Computing club ID cards for all to see. This might further increase interest in club activities among their peers.

6 Conclusions

We presented the reasoning behind the introduction of a "token of belonging" for members of a Women in Computing club. A special ID card was printed at no cost to the students and with absolute minimal effort to "sign up for it." We spread the "rumor" that only club members would be eligible for free attendance at the virtual Grace Hopper Celebration. We are encouraged by the interest of the students and intend to continue with this initiative at the beginning of every future semester.

Acknowledgments

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