

# Using departmental surveys to assess computing culture: Recognizing and addressing gender differences

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## Abstract

This paper describes a survey we created to assess the state of our respective departments. The results revealed that male and female students may hold very different views about the same department. We describe a set of changes that were implemented in response to our findings and argue that a process of continually surveying students is vital to the maintenance and evolution of a healthy computer science program.

## 1 Introduction

Margolis and Fisher, in their recent book *Unlocking the Clubhouse: Women in Computing*[6], did an extensive examination of the culture of computing at Carnegie Mellon University. In the final chapter, they discuss the implications for other institutions and suggest that a first step to attracting and retaining female students is “to take the time to survey the local landscape, talk to students and faculty (perhaps through a nonthreatening third party), and prioritize interventions that focus on the most urgent local issues.[6, page 141]”

In keeping with these suggestions, we developed a survey, shown in Figure 1, to assess the state of our departments and to better quantify any problems that needed to be addressed. This process of surveying our students revealed some interesting differences in perceptions about computer science that divided along gender lines and also proved to be a very fruitful impetus for change. We believe that other institutions would benefit from conducting their own surveys.

This paper first explains the current situation at our two institutions, and then describes and contrasts our

survey results. Finally we discuss the changes we are implementing in response to the survey’s findings.

## 2 Situation at Bryn Mawr College

In 1999, Bryn Mawr added computer science to the college’s undergraduate academic programs. We are currently engaged in the expansion and design of the program. Margolis and Fisher have reported that a major factor that contributes to female disinterest in computer science has to do with the fact that female orientation and concerns about computing are different from the design of most computer science curricula. They have claimed that universities have historically developed computer science courses with a male bias. Thus, even the introductory courses in computer science are built around “male preferences” focusing on the very technical aspects from the very beginning. Further, based on interviews of over 100 female college students they concluded that the female expression of lack of interest in computer science is really based on lack of confidence[6].

While there exist prescribed and authoritative guidelines for a curriculum in computer science (the ACM has announced a new basis for computer science curricula[2]), we are going about the design of our curriculum in an extremely independent and deliberative manner. This is partly in resonance with the findings of Margolis and Fisher, and largely based on our own experiences and similar findings at Bryn Mawr and at other universities. At Bryn Mawr, we are taking the challenge of engagement of women in computer science as our primary concern. Several design considerations have gone into the creation of our computer science curriculum that go beyond the specific guidelines prescribed by standard curricular documents. While these *patterns of curriculum design* and the motivations underlying them are detailed elsewhere[4], we are also involved in an ongoing evaluation of the changes we are incorporating in our curriculum.

While Bryn Mawr is a women’s college, it forms a collab-

## CS Department Survey

We would like to hear your opinions regarding the state of the CS department. Please do not put your name on these; we want them to be anonymous.

### Part A: Personal data

1. The highest level CS course I have taken (or am currently taking) is: a) CS1 b) CS2 c) CS3 d) one course above CS3 e) two or more courses above CS3
2. I am a: a) freshman b) sophomore c) junior d) senior
3. I am: a) female b) male
4. I am, or I'm thinking about being, a CS major or minor: a) yes b) no
5. We think that there are many good reasons for students to take CS courses who are not, nor plan to be majors, however, if you answered "no" to the previous question, we would like to hear why you are taking a CS course.

### Part B: Ratings

1. Compared to other courses at this institution, CS courses are how intellectually rigorous? a) much less rigorous b) less rigorous c) about the same d) more rigorous e) much more rigorous
2. Rate the amount of class participation in CS classes to the amount you think there should be ideally. a) much less b) less c) same d) more e) much more
3. How comfortable do you feel participating in CS classes as compared to how you feel participating in non-CS classes at this institution? a) much less comfortable b) less comfortable c) about the same d) more comfortable e) much more comfortable
4. The quality of your interaction with CS faculty (in class, during office hours, etc.) as compared to other faculty at this institution has been: a) much worse b) worse c) about the same d) better e) much better

### Part C: Short answers

1. Is the CS lab an environment that is conducive to working on CS assignments? What are good and bad aspects of the lab environment?
2. What do you think are some good things about the department?
3. What are some things that you would like to see improved about the department?
4. If there are things that you would want changed, in what ways could these changes be implemented?

Figure 1: The survey used as the basis for this paper.

orative consortium with two nearby colleges: Haverford College and Swarthmore College, both of which are co-educational. Students at these three colleges can enroll for courses on any campus. This situation is particularly well exploited by students at Haverford and Bryn Mawr as these two institutions are much closer to each other than Swarthmore College. Consequently, computer science courses at Bryn Mawr college routinely include a healthy percentage of students from Haverford College, most of whom tend to be male. Thus, issues surrounding gender differences are almost as likely as any place else to creep into our classes at Bryn Mawr College. Besides being conscious and extra sensitive to these issues we also try to keep an active survey of the effects of gender attitudes in our program.

Our goal for the survey is to monitor the gender attitudes in our program and also to keep a running tab on the evolution of our new program as we continue to incorporate more gender sensitive design patterns in our curriculum.

## 3 Situation at Swarthmore College

Swarthmore College created a provisional computer science program in 1984, starting with a single full-time faculty member. The program was converted to a permanent department in 2001, and now has four full-time faculty members. Over the past 18 years the department has grown significantly from enrollments of 30 students a semester in the beginning to 200 students per semester today.

During this period of rapid growth, the faculty began to notice a change in the departmental culture from a friendly, collegial atmosphere, where all the students knew one another, to a gradually more impersonal and competitive environment. A number of students, especially female students, began to complain of other students' aggressive behavior in the classroom and the departmental labs. We became concerned that this change in the departmental culture would tend to discourage the women and minority students that we hoped to attract to our department.

Our goal for the survey is to try to discover the causes of this less collegial atmosphere and to try to implement changes that will improve the environment for all students. We plan to continue to use the survey to determine whether the changes we implement will have a positive effect on the students' attitudes.

## 4 Survey results

The survey we developed, see Figure 1, was divided into three parts. Part A was used to collect information about each student, such as CS courses taken, class

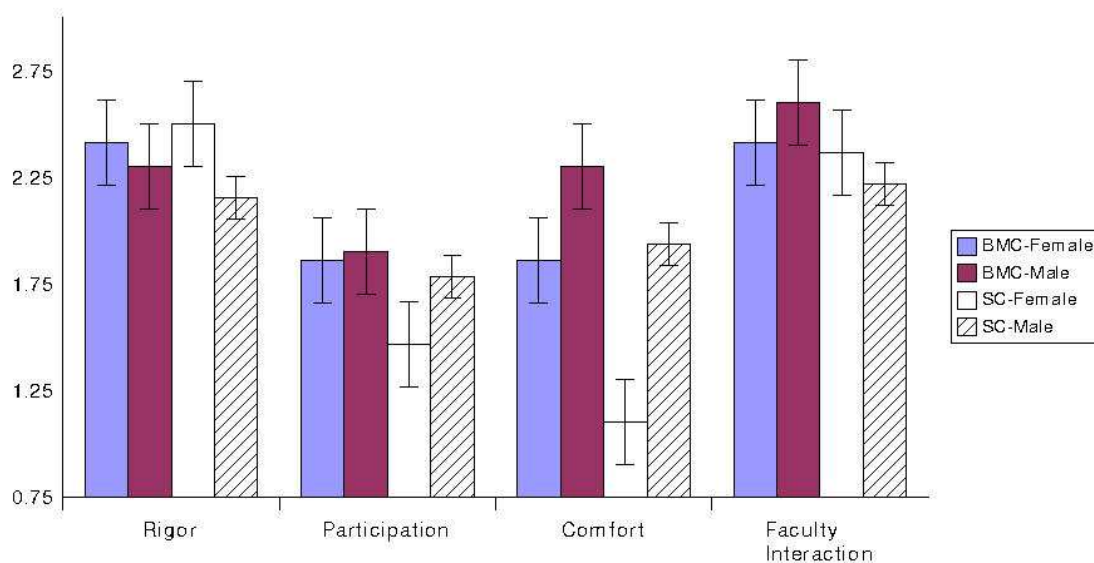


Figure 2: Mean responses to Part B survey questions at Bryn Mawr College and Swarthmore College. The X axis represents the survey question, and the Y axis represents the mean response to the question (with a range of 0–4, and 2 being neutral). The data was collected during the Spring semester 2002. The total number of Bryn Mawr students responding was 39, with 10 males and 29 females. The total number Swarthmore students responding was 94, with 64 males and 30 females.

standing, gender, and whether the student had already chosen or was planning to choose CS as a major or minor. Part B was used to quantify how the students viewed the CS department relative to other departments at the institution in terms of rigorousness, amount of class participation, comfort in class participation, and interactions with the faculty. Finally, Part C was used to give the students a more open-ended forum for discussing any positive or negative things that they had observed about the department.

In analyzing the survey results, we coded the responses to the Part B questions so that a through e equated to 0 through 4. For example, to question three in Part B about comfort in class participation in CS class as compared to other classes, 0 = “much less comfortable”, 1 = “less comfortable”, 2 = “about the same”, 3 = “more comfortable”, and 4 = “much more comfortable”. In all four questions of Part B, a 2 is the neutral response, meaning that the student does not perceive a difference between CS and other departments.

The survey results for both Bryn Mawr College and Swarthmore College are shown in Figure 2. The bars in the graph represent the mean values of the coded responses. Overlaid on the bars are 95-percent confidence intervals on the means. Considering the Swarthmore College results first, the graph shows that female and male students have different perceptions of the department. Women believe that computer science is more rigorous than the men. Women also believe that there

is less participation in CS classes than there should be ideally, as compared to men. The most significant difference between women and men, however, is in their comfort level in class participation.

For Bryn Mawr College, the graph shows that men and women students share more similar perceptions about the CS department. The only significant difference here is that women again feel less comfortable participating in class than men. However, the discomfort of Bryn Mawr students is not as pronounced as that of Swarthmore students. Interestingly, the Swarthmore men were also less comfortable participating in class when compared to the Bryn Mawr men. These data suggest that the ratio of male to female students in a classroom affects the comfort level in participation for *all* students, regardless of gender.

Margolis and Fisher note that “female students in technical disciplines, perhaps partly because of their ‘outsider-ness,’ are especially vulnerable to poor teaching, inhospitable teaching environments (such as large classes), and unhelpful faculty” [6, page 83]. Interestingly, men and women students at both Swarthmore and Bryn Mawr rated their interaction with the CS faculty as better than with faculty in other departments. So it appears that the faculty are not the main issue here. Based on the responses received in Part C of the survey, it appears that a key problem at Swarthmore is other aggressive students, who tend to dominate the classroom and the lab.

## 5 Impetus for change

At Bryn Mawr the survey results have helped us to modify our new and evolving computer science program to better address the gender differences we discovered. In creating our curriculum we are considering the number of required courses for a major, the incorporation of “humanizing” elements in what are considered core computer science courses, the deliberate introduction of problems and examples from diverse disciplines outside of computer science, as well as the offering of several new courses with a computer science orientation in the freshman writing seminar program. The focus is on attracting more female students into computer science, not just by attracting them to pursue a computer science major, but also by encouraging students to consider combining any major at the college with a minor in computer science (for examples, students in english, psychology, french, physics, mathematics, geology, etc. have completed a minor in computer science). We are also attempting to provide entry for non-computer science majors into specially designed upper-level computer science elective courses. See [4] for more details on these.

At Swarthmore, the survey results have led us to implement a number of changes: setting ground rules for classroom participation, instituting a new set of lab rules, introducing extreme programming[3] practices in introductory courses to promote interaction among students, creating a women’s support group of faculty and students, and starting a mentoring program where upper-class women in CS act as big sisters to freshmen female students. We will discuss each of these in more detail below.

On the open-ended portion of the surveys, both male and female students complained that certain individuals would often dominate classroom discussion, making it difficult for other students to participate. Students also felt intimidated by these aggressive students who tended to jump in and answer another student’s question before the professor could respond. To try to change these dynamics, some faculty instituted a set of rules for classroom participation:

- Students should raise their hands and wait to be called on.
- Students should listen to and respect other students’ opinions.
- Students should refrain from side conversations during class.
- Students should be willing to table a discussion for a later time, when the instructor decides it is time to move on to another topic.

After explaining these rules to an upper-level course this semester, a number of students came up after class to say that they appreciated this new structure. It remains to be seen whether these rules will have a permanent effect on the classroom dynamics.

We also heard numerous complaints about problematic behavior happening in the departmental labs at night, when faculty were not present. We instituted a set of lab rules, and each faculty member discussed these new rules in their classes. In addition, the rules were prominently posted in the departmental labs. Here is the short version of the rules:

- Be respectful of others.
- Use an indoor voice.
- Bring headphones to listen to music.
- Anyone may turn on the lights.
- CS work gets priority on the computers.
- Please notify the faculty of violations.

Students reported that they wished they had more of a chance to meet their fellow students. A number of students mentioned that they still did not know the names of some of their classmates with whom they had shared several classes. Some research suggests that it is important to promote interaction among classmates in order to better retain female students [5]. In order to create more classroom interaction we are now emphasizing the extreme programming principle of pair programming in our CS1, CS2, and CS3 courses [7]. In pair programming students always work with a partner at a single computer. They must interact in order to solve the problem. We are having students switch partners each week during in-class exercises so that by the end of the semester they will have met all of the other students in the class.

In order to provide our female students with a forum for better discussing the issues raised by the surveys, we created a *Women in CS* group made up of female CS faculty and students. We meet monthly for lunch. Some lunches have a designated topic, such as how to apply to graduate school, and other lunches are purely social. A report done at MIT found that it is important to encourage and support social forums for female students in CS to help them feel less isolation as a minority in the department[1].

Finally, a number of studies recommend that role models or mentors are a key way of retaining female CS students [8, 5]. We are just starting to implement this new program. We currently have eight upper-class women

who have volunteered to serve as mentors and have contacted the approximately twenty new women students to let them know of this opportunity.

## 6 Conclusions

We are discovering that a process of continually surveying students is vital to the maintenance and evolution of a healthy computer science program. It helps us make adjustments by identifying emerging trends and shifting attitudes. We believe that other institutions would benefit from conducting their own similar surveys.

Perhaps an even more important lesson we are learning is that if we are to ensure that students are engaged in our discipline, we have to think beyond fulfilling the criteria established by standardized curricular documents. While these documents play an important role in establishing guidelines, they are at best only that: a guideline. Specific instantiations have to take into account multitudes of other overriding concerns some of which may be limited to localized situations and cannot be widely adopted as such.

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