

# **Making a Difference on \$10 a Day: Creating a “Women in CSE” Seminar Linked to CS1**

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## **Abstract**

Computer Science and Computer Engineering programs across the country are increasingly concerned about the lack of women pursuing computer-related fields. To address this issue, we created a one credit seminar focused on the recruitment and retention of women in technology. The seminar targeted undergraduate women who were co-enrolled in introductory programming at a four year research institution. For approximately \$500 per quarter, a staff member and an undergraduate teaching assistant ran the Women in Computer Science and Engineering (WICSE) seminar. The syllabus was shaped by the instructors' personal experiences, and research studies on gender disparity in computer science and engineering. Throughout the quarter we brought in guest speakers, visited research projects, and held discussions. Our activities concentrated on fostering a sense of community, encouraging a wider and more accurate view of computer engineering, and offering a safe environment for discussion and debate. At the end of each quarter we surveyed the students and found that they had uniformly positive reactions to the seminar. The women felt more comfortable in their programming course and became excited about the field of computing. Our paper will outline what we learned during our first three offerings of the course, and how we plan to improve upon our experience in the future. We will show how we developed creative solutions to support women in technology with minimal department resources.

## **Introduction**

The University of Washington is a large research institution with nearly 40,000 students, 28,000 of whom are undergraduates. The university is just over 50% women but the Computer Science and Engineering (CSE) Department has held steady with roughly 17% women for the past several years. High achieving women are going into fields such as bioengineering, chemistry, math, business, and biological science, but not computer science. Research by Jepson and Perl show that the misperception of computer science and the lack of supportive communities are two of the major reasons women choose not to pursue computer science degrees.<sup>1</sup>

As with most CSE programs across the nation, our institution struggled to increase the number of women pursuing computer science degrees. In an attempt to address this problem we researched some of the possible approaches to stop women from opting out of the CSE curriculum. Cohoon states that the presence of supportive peers can greatly aid in the retention of women in this field.<sup>2</sup> One step we took to encourage women to pursue computer science was to create a one credit seminar for women who would simultaneously enroll in introductory programming (CS1). One of the seminar leaders had participated in a Women in Science & Engineering (WISE) seminar linked to general chemistry. We used the basic structure of that course for our Women in Computer Science & Engineering (WICSE) seminar.

The unique teaching model used for the seminar, which included co-instructors who were non-faculty, served as the essential element of the cost-effective, informal seminar experience. The remainder of this paper will describe the overall structure of the seminar, the curricular content, student reactions, lessons learned, and future plans.

## **Seminar Overview**

### General Structure

The University of Washington operates on a quarter system where students take approximately 15 credits per quarter. Students spend their first one or two years as a pre-major before deciding which major to pursue. During their first two years students take prerequisite courses, such as CS1, which they need to apply to several competitive engineering majors. CSE at our institution is considered competitive, since approximately 35-45% of students are admitted from each applicant pool.

The WICSE seminar, co-led by an undergraduate advisor from the CSE department and an undergraduate computer engineering student, was offered for one credit, graded credit/no credit. The seminar was held for an hour, each week of the 10 week quarter. Even though students needed to be enrolled in CS1 to be in the seminar, the material presented in the seminar and the grades assigned were separate from the material and grades they received in CS1. Grades for the seminar were assigned based on participation and quality of work on several short assignments.

### Recruitment

The primary audience for the seminar consisted of freshman and sophomore pre-majors. As Cohoon recommends, students need to be recruited during their first two years at a university. At most institutions the first two years are when women, who may be considering other majors, can be introduced to the possibilities in a computing field.<sup>3</sup> The first quarter we offered the seminar, we were not ready to start recruiting until a few weeks before the quarter began. As a result, the main recruiting effort targeted students who had finished registering. Advertisements were sent through email to all women currently enrolled in CS1, all pre-engineering students, Women in Science & Engineering (WISE) coordinators, pre-major advisors, and the math, business and honors departments.

Following our first quarter, we continued to use email to reach potential students for the seminar. Some students had even begun to hear about the course from fellow students. We expanded our recruiting pool this year by obtaining email addresses for all incoming freshman and transfer students.

The passage of Initiative-200 in Washington State creates special challenges for efforts such as this seminar. Under I-200, all state organizations are banned from using preferential treatment in public employment, public education or public contracting on the basis of race, sex, color, ethnicity, or national origin. We created an application process for the course which complied with I-200. The application process required students to state their interest in the subject matter. As it turned out, no male students took the class over the three quarters we offered the seminar.

With targeted recruitment, primarily consisting of email notification, 12 students registered for fall quarter, 12 registered for winter quarter and 19 registered for spring quarter. Four of the 19 students in spring had taken the course in winter and wanted to take the seminar for a second time while in CS2.

### Funding

The CSE department was very supportive of the seminar concept, but as with most state institutions, resources are scarce. A success of our seminar was that it required minimal financial resources to operate. The CSE department agreed to fund one undergraduate TA for the first (trial) quarter. The staff member came “free” as there was no additional salary on top of regular compensation. The TA salary came to about \$350/qtr and was the most expensive part of the course. Additionally, there was a \$150 donation that was used sparingly over two quarters to pay for morale boosters such as cookies every few weeks, a pizza lunch one day, and thank you gifts for our student research presenters.

### Staffing

Appropriate staffing of the seminar is essential to its continued success. First, the department needs to be committed to supporting one fulltime undergraduate student at approximately 3-5 hours/week in addition to a staff or faculty advisor. While in the beginning the seminar planning required 5 hours a week, once the course was rolling, planning only occupied a few hours a week. Those hours were spent meeting with individual students, discussing future sessions, or arranging for visitors.

### *Undergraduate Teaching Assistant*

Recruiting an energetic and dynamic junior or senior student is paramount. Our undergraduate TA was a senior computer engineering major who was passionate about encouraging more women to join computing fields. She brought a number of creative ideas to the table and served as a role model for the seminar students. She was able to speak about her personal experience in the major and to address any concerns that the students expressed about their programming course.

### *Undergraduate Advisor: Professional Staff*

Our university advising program consists of full time professional staff advisors who work with both prospective students and current students. Advisors are employed by individual departments or units. The advisor position for our seminar was just as critical as the undergraduate assistant. She collaborated with the undergraduate instructor to develop material, managed recruitment and enrollment, and counseled the seminar students in how to prepare for applying to competitive majors. The advisor provided stability to the seminar. The undergraduate teaching assistant graduated and the advisor trained her replacement.

### **Course Content**

In this next section we will lay out the curriculum for the WICSE seminar. Our goal of running a relaxed, yet informative, course led to having a varied structure that encouraged interactions between the students, the presenters, and the co-instructors.

### Classroom Set-up

We feel that the optimum classroom arrangement for a course like this is to have the flexibility to move chairs or desks into a large circle. Circles immediately provide a visual cue that everyone is on the same playing field. It was easier to engage the students when we were all facing each other.

### Course Introductions

During the first class session it was important to begin establishing community and trust among the students. We started with general explanations of the syllabus and followed with instructor backgrounds and how we wanted to help them explore a future in CSE. We then launched into an 'ice-breaker' that encouraged the students to learn about each other. Finally, we had everyone introduce themselves to the rest of the class.

The students were also asked to participate in a warm-up activity where they listed three adjectives that they would use to describe themselves, and three adjectives they would use to describe a computer scientist. Our goal was to see how much of a disparity there was between their perceptions of themselves versus computer scientists. We used those results throughout the quarter to show that computer scientists have traits they can identify with, since few of the students identified similar traits between themselves and computer scientists. Next year we hope to have an initial survey that will mirror the end of quarter survey to help us determine how student's perceptions change, if any, over the course of the quarter.

### History Lesson

The second class session was used to paint a historical backdrop of how women have contributed to computer science. As Townsend suggests, historical role models can have a positive impact on young women.<sup>4</sup> One of our graduate students devised a 'game show' that incorporated accomplishments of women in CSE. First, the graduate student gave a brief overview of the history of women in computer science and then the students formed groups of three to four.

While in these groups they would try to answer questions about various pioneering computer science women. The graduate student also developed 'trading cards' with biographic information of these women that he used as awards when students answered correctly. Building ties between the students and educating them about the history of computer science were the two primary goals of this activity. The light-hearted approach to the historical presence of women in the field of technology helped us achieve those goals.

### Assignments

As the course progressed, we developed a structure which encouraged students to become more engaged in the content of the seminar and helped them understand what they would need to do to succeed in the course. By spring quarter there were two short writing assignments and a point system for how students would be assigned credit. The paper assignments served as a way to get the students actively thinking about a topic that we would later discuss in class. Copies of the assignments and full syllabus may be viewed on the course webpage.<sup>5</sup>

### Research in Action

The students visited a variety of research labs within the CSE department. Our goal was to showcase different types of research that they may have an opportunity to participate in as a CSE student. We wanted to get them excited about being involved with research from the beginning of their experience with the department. With every research visit we emphasized that computer science is more than just sitting in front of a computer all day. We felt that it was important to highlight the interactive, creative side of the computing field.

The first demonstration was by a fellow undergraduate who showcased the Robo-Dogs project<sup>6</sup> (Sony AIBO dog robots playing team soccer). The students enjoyed learning how the dogs interacted and about the opportunities available to them if they ended up joining the department.

The next research visit was to the department motion capture lab. Two graduate students donated time to show the women how they used motion capture to create animation.

During spring quarter our class was invited to visit Seattle's Intel Research Lab for lunch and a presentation on embedded hardware. The students learned about a project designed to extend independent living for the elderly. The Intel project was an example of how computers can improve people's lives. As studies have shown, the more we can highlight the humanitarian aspect of computing fields, the more successful we may be at recruiting women.<sup>7</sup> One of our students was so intrigued by this project that she inquired about undergraduate research, and began working at Intel.

### Faculty Visitors

Our first two quarters we invited faculty to visit the course. We thought it would give the students an idea of what faculty research entails and make the faculty more "real" to the students. Surprisingly, this structure was not as successful as some of our other events. One possible reason for this is that the students were already 'maxed out' from listening to lectures in their other courses. Or, they had become accustomed to our more interactive course structure and the traditional lecture was too much out of context. Students seemed to respond much better to non-traditional teaching styles such as discussions, informal presentations, and active participation.

### Industry Visitors

The students were concerned about applying to the major and about coursework once in the major, but they seemed curious about what types of jobs they could pursue with a CSE degree. To address this question, we brought in several representatives from industry to discuss the wide variety of opportunities open to students in computing fields. Our guests came from large local corporations and small, start-up companies. One industry visitor was from a small video game company geared toward creating video games for girls while another visitor came from a large local software company.

### Group Discussions

Admittedly, group discussions were one of the most difficult activities to organize and to make relevant. We tried different approaches; for example, we asked students to write up brief position papers on the effects of local initiatives on higher education, but it was often difficult to keep the discussion flowing. Discussions were most effective when given towards the end of

the quarter. At the beginning of the quarter most of the students did not have much of an opinion regarding gender and computer science. Once they had been in CS1 for awhile, they could express their frustrations and accomplishments in the course and begin relating their experiences to broader topics.

Our most successful discussions occurred once we had gained the trust of the students and they were able to speak openly regarding their fears about computer science. Our choice of co-instructors gave students resources for some of their most immediate questions regarding the admissions process and the difficulty of the curriculum. Each of the co-instructors could speak to one of those questions with personal insight and experience.

### Student Response

The students consistently rated the overall seminar experience above 4.0 on a 5 point scale during end-of-quarter evaluations. By winter quarter we had decided to include both a mid-quarter and final evaluation. These general surveys helped us to understand what was working well and what was not working. The surveys were uniformly positive for all three quarters. We have included a few excerpts below.

#### What have you liked about the seminar?

- Being able to talk openly with people who care about what is being said. It doesn't feel like a class, but instead a real bonding time with people in the same boat. If I was in this class without knowing anyone, I'd feel so alone & intimidated. This class has calmed my anxieties so much.
- I like the way that you took us to visit a few sites and see what actually computer science does out in the world. I was not aware that it did so much.
- I liked [the seminar], it made me think about [a] career in computer science because of all the cool and neat things that you could do within the field."

#### What aspects of this class contributed most to your learning?

- I think this class was awesome! It helped me realize CSE is more than coding all day. It was also really nice to get to know other people in the CS1 class because it was so big. I think it helped my confidence & my grade. Every week was something new and interesting. You did an awesome job! Thank you.
- I learned about other careers in computer science outside "the traditional." It was interesting to see how it could be applied to/different subjects like biology. Learning about women's contribution in CSE was great. The guest speakers were very informative, occasionally entertaining.
- R[i]diculously friendly, supportive environment. Help, advice, & encouragement were all supplied generously. It was a very informative and well-thought-out seminar. It also encouraged me to perform well in my CS1 class!

#### Has this seminar helped you feel more comfortable in CS1?

- This seminar has helped me enjoy CSE a lot more. I think I feel more motivated in CS1 knowing what opportunities are available.

- This seminar has definitely helped me feel more comfortable in CSE. I was worried before about being a girl in CSE, but now I know I am not alone!”
- Yes! If I was in this class without knowing anyone, I’d feel so alone and intimidated. This has calmed my anxieties so much!

### Summary Results

The women accomplished the goals we set out for them at the start of the course. The evaluations showed that almost every student learned that computer science is more than just programming. Our small group setting helped these students meet each other and create a support network where they felt comfortable sharing their frustrations, confusion, and excitement.

### **Lessons**

We felt that the course was successful. The students had nearly perfect attendance every quarter and their evaluations were always high. Additionally, when we offered students in the winter quarter section the opportunity to take the seminar again in spring quarter, four students took the seminar for a second time. We watched these seminar ‘veterans’ build a strong bond as they helped each other through the second programming course.

Having passionate seminar leaders is crucial. The energy, excitement and willingness of the instructors to try new activities and to connect with their students are paramount. For our structure, the combination of an undergraduate and a staff member worked well. Although it seems obvious now, it would have been helpful to ask at the start of the quarter if any of the women had specific interests in the field. Although our goal was to introduce the students to a broad array of CS related topics, one of the assignments in particular would have been more meaningful if students wrote about an area that truly interested them.

Interactive activities and informal speakers were the most successful class sessions. Students wanted to share ideas, ask questions, and see interesting projects. Topics such as college course curriculum and job opportunities interested the students because it expanded their view of computer science and made the career options more of a possibility for them as individuals. Computer science was not very concrete for these women, and these activities gave them details on what they could do after earning their degree.

The culture of the CS1 course itself greatly impacted the environment of the seminar. When the students were having a positive experience in CS1, their attitudes in the seminar tended to be positive, and when they were having a negative response to CS1, they were consistently more negative in the seminar. In the cases where negativity began to surface, it seemed even more important to help the students focus on what was beyond CS1.

When students in the seminar started showing signs of frustration in CS1 the WICSE seminar acted as a focus group on the overall impact of their programming course. The students became comfortable enough in the seminar structure that they would discuss their concerns, frustrations, and enjoyment of various aspects of CS1. The students seemed to really appreciate an opportunity to share their experiences with each other, and as representatives of the department, it was helpful for us to hear the student’s opinions. This free flow of information allowed us to identify some issues in the introductory courses that may have been impacting diversity.

## **Future Plans**

### Informal Gatherings

Several students wanted the course to meet more often. Although we do not feel that it would be practical for the seminar to officially meet more than once a week, we agree that additional out of class activities should be planned in order to help the students become better acquainted with each other. One idea for the upcoming year is to have an industry-sponsored dinner during the first week. This informal gathering of the students would begin fostering connections among the students. The challenging part is trying to find a time that 10-15 students can all meet. However, for those who are able to attend, it would be an early step in creating relationships that we can build on for the remainder of the quarter.

### Special Study Sessions

We also plan to incorporate extra study sessions for the students in the seminar. We hope to hire a CS1 TA to meet with the students for two hours per week to go over course material and provide an opportunity for the students to work together to solve problems. Originally, we did not want the seminar linked too closely to CS1 because it was feared that if students saw this as a way to get extra help, we would be inundated with people outside our target population. There was also concern that we would send the wrong message by assuming that women needed extra help. In order to combat these stereotypes, we hope to structure these additional sessions as voluntary study sessions where students can meet to work on homework. In order to make these sessions more appealing, we plan to offer them during evening hours which is when most students tend to work on homework and we will invite all women in the CS1 course. We hope that it will become a safe place for women to ask questions and discuss concepts that they may be too timid to bring up in lecture or in their official quiz sections. There is currently a structured after-hours study session for freshman and sophomores. Our plan is to incorporate our students into this established system.

### Improved Discussions

The discussion sessions were definitely the weakest part of the seminar. We plan to provide more journal readings for the students and ask them to come up with some of their own suggested discussion topics. Instead of choosing what to cover, we will rely more on what the students are interested in talking about throughout the quarter. The journal articles will provide more context for the students to initiate a discussion which will then lead to more general, open discussions about their concerns. We will also hold the discussions later in the quarter to give the students more of a chance to have some personal experiences to contribute.

### More Career-related Guests

The students were curious about the type of work a CSE degree would allow them to do once they graduated. We would like to build up our industry representative pool in order to have a wide variety of speakers to bring in from quarter to quarter. The process of finding dynamic women, in interesting computing areas, who are able to take time to travel to campus, can be a daunting task. But it is certainly an activity that pays off when it works. It is very important to locate people who are adept at talking to audiences with limited backgrounds in the field. If speakers talk over the students' heads, the students become frustrated.

### Mentors from the Department

We hope to pair up each woman in the seminar with a female undergraduate CSE major. As Stanford researchers discovered, and we agree, the stepping-stone role model approach works best because students can see themselves following in these students' paths.<sup>8</sup> They serve as a representation of realistic goals. Whereas students may have trouble identifying with faculty, they can easily identify with a student who is just a year or two ahead of them.

We are in the beginning stages of starting an ACM-W chapter at our institution, and it is our hope that the women involved with this organization will be the backbone of our mentorship program. There are now four women who are seminar graduates in our major and all are tremendously excited to become involved with the ACM-W and to work with the next group of seminar students. This mentorship program will continue providing support to women after they finish the seminar.

### Continued Support in CS2

This past year, we had four students from our winter seminar who took the course again during spring quarter. Although there were several benefits to having these four students in the course for a second time, there were also a couple of drawbacks. The benefits included having students in the course to offer support because they had just finished CS1. The drawbacks included having to come up with new activities, and sometimes, having students at different levels.

When students first began taking CS1, they had different concerns than the students who had already gone through one course. The students in the first course were concerned about the difficulty of the assignments and did not have a clear idea as to what computer science entailed. The students in the second course were now closer to applying to the CSE department. Topics such as specific details on the application process and the CSE curriculum were more relevant for the CS2 group.

Since our department requires CS1 and CS2 before applying to the major, we feel that it is important to continue support structures for the students who continue on to CS2 when the seminar is no longer available. One option would be to create a 2<sup>nd</sup> seminar that catered to only CS2 students. This would help to keep the course material stable for CS1 while offering a similar experience to CS2 students. We may also find a few students in CS2 who did not take CS1 at our institution and therefore were never exposed to the first seminar. Another option would be to have a more informal gathering or series of events for the women in CS2, either all women in CS2, or just the graduates from the seminar.

### Further Research

It is still too early to tell whether or not this seminar significantly impacted the students' decisions to pursue computer science or computer engineering as a major. However, we plan to follow these students during the next couple of years as they finalize their fields of study. There were 20 students from our fall and winter seminars who were eligible to apply to our department this past year. From that group, three applied and all three were accepted. One additional seminar student was admitted early to our major, so she was already a member of the department while enrolled in our course.

## Conclusion

This seminar is not the only program that our CSE department is using to increase diversity. It is, however, a low cost approach that universities can use to begin addressing some of the main issues pushing women away from studying computing related fields. We are making a difference on \$10 a day by fostering community, breaking stereotypes, and providing positive role-models.

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## Biographical Information

**CRYSTAL ENEY** has been an advisor for the Computer Science & Engineering (CSE) Department at the University of Washington for five years. Previous to that she was a student at the University of Washington where she earned degrees in history and psychology. One focus of her work within the CSE department is recruitment and retention of women into CSE.

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