

A FIRST YEAR SEMINAR'S IMPACT ON INTEREST IN COMPUTER SCIENCE

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ABSTRACT

While enrollments in computer science courses may be increasing overall, the recruitment and retention of women and minorities in computer science remains a pervasive problem. First Year Seminars at universities are relatively common, and though they take on a variety of formats, many are designed to help with the transition to college and to increase retention. For three years, a computer science faculty member taught a First Year Seminar, broadly about the Internet, though with limited technical details, surveying the students about their perceptions of computer science. The results, while not conclusive, may provide motivation for other computer science professors to teach a First Year Seminar related to technology.

INTRODUCTION

Background

Despite the increasing enrollments in computer science courses that many universities are experiencing, women and minorities remain underrepresented in computing, with the Taulbee Survey reporting that of the bachelor's degrees earned in computer science in 2013-2014 only 14.1 percent were earned by women, 6.0 percent by Hispanics, and 3.2 percent by African-Americans [12]. Notwithstanding years of initiatives and research with aims of broadening participation in computing [9], recruiting and retaining a diverse population at all levels in computer science is not straightforward, with major corporations funding efforts to try to solve this problem [10]. There is even reason to believe that increasing enrollments in computer science may be detrimental to diversity efforts [3].

Many institutions offer a First Year Seminar (FYS) and while these seminars take on various forms, frequently one of the goals is student retention, which is achieved with some success [8]. A variety of FYS experiences related to computer science have been tried and reported on in recent years. Shippensburg University included a 'boot camp' component as part of the CS1 lab for majors, with an emphasis on soft skills necessary for the major and a fuller understanding of the departmental offerings [2]. Purdue University offered a seminar titled "Women in Technology: Exploring the Possibilities" whose participants consisted solely of female students in the School of Technology [11]. Other institutions have offered seminars with content that could alternatively be elective courses in a computer science major, including ethics, cryptography, and the life and work of Alan Turing [7,1].

Project Goals

Like many liberal arts colleges, Southwestern University requires all entering students to take a FYS. These courses, which serve as an introduction to college-level work and inquiry, often with an emphasis on writing and discussion, are not intended as a source of disciplinary content. Faculty members from across the university teach more than thirty seminars on a diverse set of topics. Students rank their preferred seminars from the title and description, but are not explicitly provided the name or department of the instructor. Students typically receive one of their preferred seminars, though factors such as space, efforts to diversify the student body in seminars in various ways, and sometimes differential costs in dorms when seminar cohorts are housed together are used in making FYS assignments.

When the author was first applying to teach FYS, very few women at Southwestern University were majoring or minoring in computer science. Thus, one of the author's hopes was that teaching an FYS could perhaps make computer science more appealing to women and minorities, both to the students in the course, and by extension, their peers, since students talk about their FYS courses and faculty. Though not specific to computer science, work of Machina and Gokhle suggests that including science content in first-year seminars does in fact prevent what is otherwise a decline in engagement with science and technology for women [5].

Likewise, having taught introductory computer science classes, the author had anecdotally experienced the phenomenon observed by Madigan et al. that first-year students (male and female) "have greater confidence than actual skill" in information and computing technology, and that even though female students had comparable skills to their male peers, many "do not perceive themselves as competent users of technology" [6]. Giving students a course where learning technical knowledge was not a primary goal, but where they could ask questions about a variety of aspects of technology, anonymously if they wished, could potentially help students both realize their competence and more accurately assess their current knowledge relative to their peers. Perhaps similar to the outcomes of the multidisciplinary courses tried at another liberal arts college, an FYS related to technology can result in more students later taking a course in computing [4].

METHODOLOGY

The author taught an FYS titled *Unweaving the Web* in Fall 2010, 2011, and 2012. Broadly speaking, the topic of the course was the Internet, including social, ethical, and technical and technological implications. Students were surveyed about their background related to computers and perception of computers and computer science. Summer reading assignments included either *Rainbows End* by Vernor Vinge or *The Most Human Human: What Talking with Computers Teaches Us About What It Means To Be Alive* by Brian Christian. The text during the semester was the most recent edition of *A Gift of Fire: Social, Legal, and Ethical Issues for Computing Technology* by Sara

Baase. There was always a substantial discussion about Wikipedia, with students gaining experience in editing pages on the site. Other topics varied from year to year, inspired in part by current news articles and student suggestions.

Appropriately designing the surveys to be able to obtain the desired information was important. Accordingly, the instructor developed the survey in consultation with a psychology professor, who provided guidance and the wording for many of the questions. Before being administered, all surveys and the research protocol were approved by the university Institutional Review Board (IRB). Due to the timing of the development of the first offering of the course and the procedures needed to obtain IRB approval, Fall 2010 students completed only a post-survey, while the Fall 2011 and 2012 classes were able to complete pre- and post-surveys.

The IRB deemed the surveys to have at most minimal risk to students, and all students were provided with informed consent documents, information that the surveys are voluntary, and time to ask questions of the instructor and their peers. Students were told that the surveys were about their background with computers and their perceptions about computers and computer science, as well as some questions about their, gender, ethnicity, and socioeconomic status. Students were required to be at least 18 years old and enrolled in the FYS to participate. They were told that the pre-survey would have a code word on it that they would be asked to include on the post-survey, but that names would not be associated with surveys or with the code words. Yet they were informed that due to the small size of the course and thus the potential participant pool, anonymity could not be guaranteed; for example, gender and ethnicity may uniquely identify a student. Students were offered extra credit for participating, but were offered an alternative activity (a brief reflection on an article from the ACM TechNews, <http://technews.acm.org/>) that was anticipated to take the same amount of time and effort as typical survey participation. The instructor submitted final grades for the course before viewing the surveys.

Students who chose to participate in the pre-survey were asked to fill out a written questionnaire during the first week of FYS, outside of the classroom. Since FYS meets during an orientation week when no other courses meet, there is ample time for students to do this, including before or after class most days. A similar procedure was followed in the last weeks of FYS (in October) for the post-survey, on which they were asked to write the code word from the pre-survey. Note that because FYS meets during orientation week, it ends earlier in the semester (ostensibly helping alleviate some of the end-of-semester crunch for first-semester students).

Each questionnaire was three pages long, with the post-survey a subset of the pre-survey, as some questions related to parent demographics would not have changed. Questions elicited information about how much students use a computer, as well as circling a variety of activities for which they may use computers. Students were asked if they knew anyone with a computer science degree, and if so, their gender, as well as

questions about what they expected someone with a computer science degree to earn and the number of hours worked per week. They were asked about any prior computer science coursework, their intentions for future coursework, and to circle or provide reasons for those responses. There were statements about computer science careers and students' own career aspirations that they were asked to evaluate using the Likert scale. Additional questions asked about students' ability, interest, and perception of difficulty of ten majors, including computer science and some of the most popular majors at the university. The survey concluded with some demographic questions.

RESULTS

Given the small sample sizes (15 students enrolled in 2010 and 2011, and 12 in 2012) and that not all students participated in all surveys, statistically meaningful observations from data from three cohorts should not be expected. Additionally, factors other than FYS that can influence students' responses, including the new experiences, perspectives, and people they are exposed to in their first months of college.

Largely, the data show that students have varied perceptions and (mis-)conceptions about computer science. Likewise, as evidenced by some survey responses that were inconsistent within a single survey (a student indicating no desire to take computer science courses because they wanted to major in X later ranking major X as least desirable among listed majors), survey data is not necessarily fully accurate. Yet some interesting information can be gleaned from student responses.

	2010, post	2011, pre	2011, post	2012, pre	2012, post
Average	28.00	39.62	35.33	36.75	30.67
Range	10-65	25-54	8-50	18-56	10-54

Table 1: Responses about percentage of female computer scientists

	2010, post	2011, pre	2011, post	2012, pre	2012, post
Average	50	46.77	39.82	40.833	48.25
Range	35-100	30-60	18-50	10-100	10-120

Table 2: Responses about hours worked per week by computer scientists

In response to the query "What percentage of computer scientists are women?" the responses varied from 8 to 65%, as indicated in Table 1. Perhaps due to some of the in-class discussions about the underrepresentation of women in computer science, the averages decreased from the pre-surveys to the post-surveys; yet some still reported a fairly even gender balance, not the numbers that would be expected from the percentage of bachelor's degrees in computer science earned by women. The answers to a question asking "What is the average number of hours worked by a computer

scientist each week?” are perhaps reflective of first-year college students being quite unsure what different careers will entail. As seen in Table 2, in 2011, the maximum number of hours was well within reason, yet in 2012 there were both high and low extremes. Having the pre- and post-surveys linked by code words also reveals some interesting responses, including that the individual who responded 10 hours in the pre-survey in 2012 in fact answered 100 hours in the post-survey (and the person who had responded 100 in the pre-survey increased their answer to 120 in 2012). This data can perhaps be used as the starting point for an in-class discussion in future years.

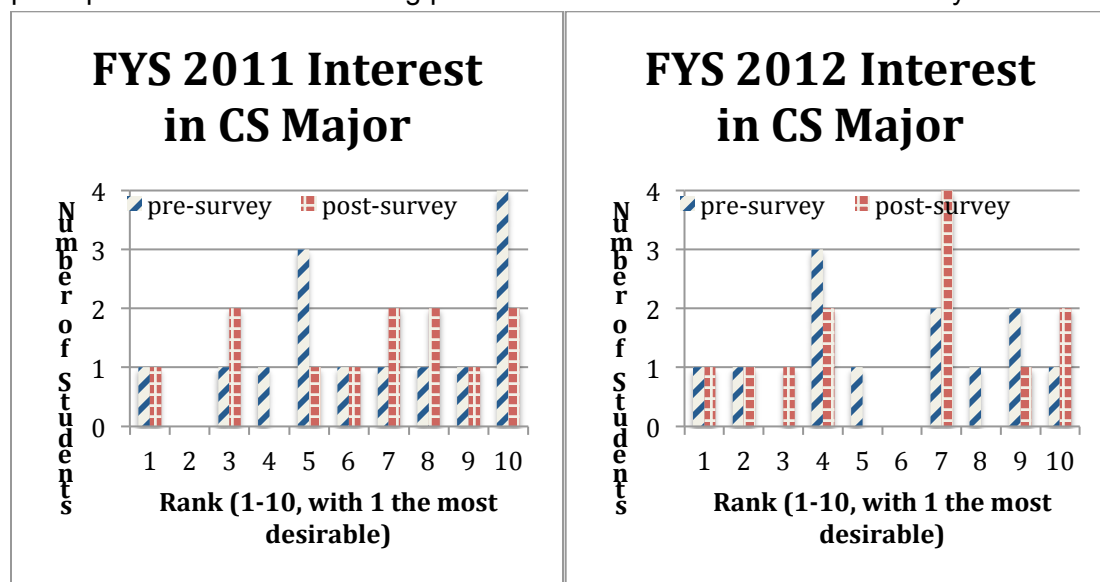


Figure 1: Reported ranks of interest in a major in computer science, pre- and post-surveys from FYS students in 2011 and 2012.

Ten majors were selected from the available majors at the institution, and students were asked to rank them from 1 (most interested) to 10 (least interested). The majors, provided in alphabetical order, were: Anthropology, Biology, Business, Computer Science, Education, English, Mathematics, Music, Psychology, and Religion. While many terms are familiar to entering students, Anthropology was purposefully selected because it is rarely a subject in the high school curriculum. Figure 1 shows the reported interest in the computer science major. In 2011 after the FYS, some students now no longer reported computer science as the least desirable major. Yet overall, reported interest did not change greatly in the two months from students’ arrival on campus.

CONCLUSIONS

Though the small sample size prevents statistically significant analysis, having pre- and post-surveys linked by code words shows that some individuals increased their desire to take a computer science course in college from the first week of FYS to the end of that course midway through the fall semester. Since the institution is small and the author knows all majors, each of these FYS classes did have one student who completed the computer science major to date. The number of women graduating with a computer science major in the past decade has increased (from zero or one, to as many

as seven per year, or approximately half of the graduating majors), outpacing the overall increase in majors; while there are no doubt many contributing factors, it is possible that an FYS related to computer science makes the major more interesting or appealing. The author plans to continue the surveys when she again teaches FYS to see if more years of results suggest additional or changing trends. When deciding whether to teach an FYS at their institution, computer science faculty can perhaps consider the potential impact on the pipeline as one factor, and conduct similar surveys of their students to determine local impact.

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