RESULTS OF A STUDENT CENSUS IN CS 2

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ABSTRACT

We report the results of an essay assignment in which CS 2 students were asked to summarize their interest in computer science or computing. We found strong interest in applications of CS, followed by love for some aspect of the field, and interest in employability as the main reasons students gave for studying CS. Students were also surprisingly forthcoming about how challenging they found the field. Beyond the specific results, we also believe the essay assignment has value as a way of starting a personal relationship with the students.

INTRODUCTION

Approximately a decade ago, there was great alarm in CS Education circles about falling enrollments. At the time, a popular explanation was the popping of the dot-com bubble and the coincident prominence in the media of stories about CS jobs being sent off shore. This led to a significant amount of work on attracting students through curricular approaches such as games [2], robots [3], and socially-relevant applications of computing [5].

Fast forward to the present and CS enrollments are booming. The authors have heard this attributed to flattering portrayals of the field in popular media, improvements in pedagogy, and the perception of employability during the recent economic downturn.

Taking a longer perspective, it is clear that CS enrollments have fluctuated widely in the past as well [6]. This presents a significant challenge in planning for the future, for example in deciding whether to hire tenure-track faculty. Thus, it is important for us as a field to develop an understanding of the factors that determine whether students take our courses and choose CS as a major. In this paper, we make a small contribution to this project by reporting on CS 2 student's self-reported reasons for interest in computer science.

In addition to learning about the interests of CS 2 students as a population, we also found it valuable to learn about the individual students in this specific class. We present some specific ways that information gleaned from these essays can be

used to support student retention, but also see the essays as helping to promote a positive student-faculty relationship.

METHODOLOGY

Our data comes from student responses to an assignment due at the end of the first week of a 10-week CS 2 course in the Winter (Jan-Mar) term of 2016. The assignment used the following prompt:

> Write a ~1 page essay describing your interest in computer science or computing. (What would you like to be able to do with your computing skills? What do you find most interesting about the field or what you've learned so far?) There isn't a correct answer and it doesn't have to be highly formal, but do proofread for spelling, grammar, etc.

This was a very open-ended assignment, originally given just as a way to learn something about the students. It was inspired by essays that the first author read as part of a summer bridge program for first-generation students; he found it both useful and enjoyable to interact with his future advisees through essays about their interests and plans before taking them through the standard course-selection process.

The prompt was given to a class of 39 students, 37 of whom completed it. The professor read each of these assignments shortly after they were submitted and wrote each student a personal response, ranging in length from a couple of sentences to several paragraphs. This was following through on the original intent of using this assignment to get to know the students. It was during this reading that he realized that the results would be of wider interest, which motivated him to go through the college IRB process and request permission from the students to share the results anonymously. Eighteen of them granted it. Both authors of this paper then examined the essays of those students, coding them for the reasons given. We also looked for other commonalities.

TYPES OF INTEREST

We identified three types of reasons that students gave for their interest. Many students included more than one of these types and in one case it was unclear which was the most important.

The first type of interest we identified was enjoyment of some aspect of computer science itself. For example, one student stated this as "Programming was fun. I loved being able to sit down with an empty page and a description of what should happen, and from there, figure out the best solution…". Others expressed it as a hunger to learn how computers worked or enjoyment of the puzzle-solving aspect of the field.

The second type of interest we identified was a desire to use computing for an application or a specific type of career. Several talked about how programming was important for running scientific equipment or analyzing the data from such experiments. One each talked about financial asset trading and LIS (Library and Information Science). Others were interested in developing video games.

The third type of interest was seeking non-specific employment. This was either expressed in very general terms like "financial success" without giving a specific occupation or by listing such a wide variety of possible occupations that it was clear that it was employability rather than any specific job that they were seeking.

In addition to a sense that the students' stated interests fell into these three types, we also hypothesize that these types are meaningful in terms of CS enrollment trends. Students with the third type of interest (general employment) are likely to be lost in something like an offshoring scare that portrays the field as one with a poor employment future. Students with the other types of interest are less susceptible to such a scare, though this observation comes with the caveats that many students reported more than one type of interest and at least some showed fluidity of interest over time, with one explaining that she came in looking for earning potential and then fell in love with the field.

Of the three types of interest, the most common was the second type, interest in an application. We identified the strongest type of interest for 17 of the students; the remaining student showed strong interest of all three types. Of these 17 students, the strongest interest for 10 (59%) of them was the second type. The first type (enjoyment) was strongest for 5 (29%) of them and the third type (employability) was strongest for the remaining 2 (12%). Looking just at students who showed a strong interest in each type (allowing students to be counted more than once and including all 18 students), 11 (61%) were strongly interested in applications, 9 (50%) were strongly interested because of enjoyment, and 5 (28%) were strongly interested in the field's employability. By both ways of accounting, the most prevalent type of interest was based in applications. This is a strong argument in favor of presenting CS in the context of applications, as has been previously suggested for recruiting and retaining students (e.g. [4]).

OTHER OBSERVATIONS

Another interesting thing that we found while reading the essays is that many students volunteered that they found computer science challenging. Of course we are aware of (and share) this perception, but we were not expecting it in the essays since the prompt does not ask for an assessment of the field's difficulty. We were also surprised and a bit flattered that the students trusted us with this; students could understandably not want to share their insecurities about the course with the person who would be grading them, particularly since this was in the first week of the course.

Students described their challenges in different ways. Some gave specific concepts (e.g. objects/classes), but most mentioned that they had struggled with CS 1 in general. Notable were a female student who expressed discomfort with the fact that the field is male dominated and several who remarked that CS was a strange choice given their other interests (2 creative writing majors); these students seem to be feeling stereotype threat (e.g. [8]), though none used those words.

An advantage of having the students bring up their concerns about the course or CS near the beginning of the term is the chance to address them. Mention

was made of the concerns in the individual responses to the essays of every student who expressed them. The professor stated he was glad that the student was in the class and that the class would be challenging but doable as well as reiterating his willingness to answer questions and other possible resources. Students expressing discomfort with the climate were told that they weren't alone (our institution's CS majors are roughly 1/3 women and a creative writing professor likes to talk about the synergies he sees with CS). Few students responded to these emails, but one volunteered that receiving the response to his essay had made his morning.

Another thing that some students volunteered despite no mention of it in the prompt was their prior programming experiences; 5 mentioned a programming experience before CS 1. Prior background has been shown to increase the chance of student success in CS both at our institution [1] and in general [9]. In principle, this information could be used to arrange student groups or track students with prior background into a separate section, but those uses would require specifically asking the students to ensure that all students disclosed relevant prior background and also probably moving the essay assignment into CS 1.

DISCUSSION

We found the student essays very interesting to read and plan on continuing to give this assignment. The submissions are useful as a reminder that students have diverse interests. We found knowing the kinds of things students had expressed interest in useful when preparing assignments and in-class examples. We also occasionally referred back to the essays when exchanging email with a specific student.

More generally, we valued the assignment as a venue for students to introduce themselves and took the task of responding to them as an opportunity to informally interact with individual students. An important aspect of the small college experience is the relationships that students develop with faculty and this assignment provides a low-effort way to start a conversation.

Although the evidence of its effectiveness is only anecdotal at this point, we also particularly like the potential the assignment gives of providing reassurance to students feeling uncomfortable with the class or CS in general. Going forward, we aspire to follow up more aggressively with these students to help them get any needed support. Since the students are volunteering their concerns and doing so early in the term, the professor can try to intervene before they actually perform poorly in the course.

To consider student motivation as a research question, there is much more that could be done to expand upon this work. The essay prompt is very open ended, which makes it non-threatening when the goal is to start a conversation with students, but the lack of structure makes it hard to interpret the responses.   We also see two other issues with interpreting the results from an informal survey such as ours. First of all, the students know they are writing to their professor and may adjust their response to please that audience. This could discourage them from expressing a job-oriented motivation. The employment-based explanations for the wide fluctuations in CS enrollments would suggest that this is a stronger motivation

than we saw. One of the students explicitly said so, claiming that their motivation "to pursue this as my career might be different from the majority of the class, which is to have a nice and secure job and future".

The other issue is survivorship bias since we assigned this essay in CS 2. The timing clearly could affect the results about how challenging students find the field since students struggling to program are less likely to persist into CS 2; this could explain why most students described their challenges in the past tense, talking about how programming used to be challenging rather than how it was challenging.

Survivorship bias could also tend to inflate the numbers of students expressing the first two kinds of motivation. During CS 1, students motivated to take the course out of curiosity or "to get a job" can discover something they like about the field or learn more about specific applications, but those who lose their original motivation are unlikely to take CS 2.

A more formal study of the reasons students take CS classes and persist in the field that wants to address these issues might be based on self-determination theory [7], which provides tests to classify people's motivation.

REFERENCES

[1] D.P. Bunde, J.F. Dooley, and J. Spacco. Making the most of the assessment process. Poster presented at the 18th ACM SIGCSE Conference on Innovation and Technology in Computer Science Education (ITiCSE), 2013.

[2] S. Kurkovsky. Engaging students through mobile game development. In Proc. 40th ACM technical symposium on Computer Science education (SIGCSE), pp. 44-48, 2009.

[3] T. Lauwers, I. Nourbakhsh, and E. Hamner. CSbots: Design and deployment of a robot designed for the CS 1 classroom. In Proc. 40th ACM technical symposium on Computer Science education (SIGCSE), pp. 428-432, 2009.

[4] J. Margolis and A. Fischer. *Unlocking the clubhouse: Women in computing*. MIT Press, 2002.

[5] C. Rader, D. Hakkarinen, B.M. Moskal, and K. Hellman. Exploring the appeal of socially relevant computing: Are students interested in socially relevant problems? In Proc. 42nd ACM technical symposium on Computer Science education (SIGCSE), pp. 423-428, 2011.

[6] E. Roberts. A History of Capacity Challenges in Computer Science. White paper. http://cs.stanford.edu/~eroberts/CSCapacity.pdf, retrieved Mar 2016.

[7] R. M. Ryan and E. L. Deci. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being, *American Psychologist*, 55, pp. 68-78, 2000.

[8] C. M. Steele. *Whistling Vivaldi and Other Clues to How Stereotypes Affect Us*. Norton, 2010.

[9] B. C. Wilson and S. Shrock. 2001. Contributing to success in an introductory computer science course: a study of twelve factors. *ACM SIGCSE Bulletin*. 33(1), pp. 184–188, 2001.