How CS Departments are Managing the Enrolment Boom: Troubling Implications for Diversity

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***Abstract*—Enrolments in North American undergraduate computer science have been booming in recent years, and many CS departments have been struggling to meet student demand. We surveyed 78 CS professors, instructors, staff, and administrators to see how the enrolment boom has been affecting their practice; and to see how departments are responding in terms of policy. We asked participants to tell us what factors were being considered in their department's policymaking using a page of open-ended questions. Only one participant of 78 noted diversity as a concern. We then gave them a list of factors we thought could affect their department's policymaking, including diversity. After this prompt, more participants reported diversity was important (n=5). We found that policymakers are favouring solutions which are intuitive to them, rather than looking for examples from the literature, similar institutions, or the history of their own institution. Problematically, many of these favoured approaches have historically been linked to having a negative impact on demographic diversity in CS programmes. This could exacerbate the low participation of underrepresented groups in computer science, and undermine efforts to improve diversity.**

I. Introduction

Computer science is an unusual scientific discipline in that the percentage of women in the discipline in the West is *worse* than it was in the 1980s. With the percentage of women in CS currently around 18% in the West [1], much effort has been going into improving gender equality in the discipline.

The underrepresentation of women in Western CS is due to a complex interaction of social, cultural, and political factors. Social factors include the changing stereotypes about technology use, such as the gendering of computer technology [2], [3]. Cultural factors refer to the culture of computing itself, which promotes "hacker culture" [4]. Finally, political factors refer to the policies used in computer science institutions, which can affect female representation.

Historically, CS has had two "enrolment booms" where the numbers of CS undergraduates sharply increased and later decreased. In the past, the approaches taken by CS departments to manage enrolment booms have affected student culture and learning [5], [6]. These approaches include restricting access to classes and majors as well as creating large "weeder" courses. These policies detrimentally altered student culture to be "defensive" in the terminology of Garvin-Doxas and Barker [7], contributing to the low participation of women [5].

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With enrolment booming again, we felt it was important to ask how CS departments are responding in terms of policy, and if diversity is being considered.

II. Methods

We surveyed CS professors in North America about what their departments are doing about the enrolment boom. Our survey had four pages:

1) Details on the participant: contact information, their role, institution
2) Has their undergraduate CS programme been experiencing an enrolment boom (yes/no). If so, how does it compare to the dot com era (greater/lesser/don't know)?
3) Open ended questions
    a) How has the increase in enrolments affected your teaching?
    b) How has the increase in enrolments affected your department as a whole?
    c) What is currently being done and/or planned to handle the increase in enrolments?
    d) What do you think about the policies/approaches your department has been implementing/discussing?
4) Pre-established factors and reflection
    a) What factors would you say are influencing your department's strategies for handling the increase in enrolments? To what extent? (a list was provided of pre-established factors, and participants indicated whether each was a major factor, medium factor, etc; 'diversity' was one of several factors such as 'classroom capacity' and 'fiscal resources')
    b) Out of the list of factors above, including any ones you added, which do you personally feel are neglected in your department's discussions but ought to be considered? Why? (Open-ended)
    c) Is there anything else you'd like to tell me about your department's handling of the enrolment boom? (Open-ended)

We determined a list of factors based on the literature [8], [9] and then, after piloting the survey on ten colleagues, we added "A sense of urgency" to the list. This list was then randomized for the presentation to each participant to mitigate any bias coming from the order of the factors.

We intentionally asked participants how the boom had been affecting their teaching/department *before* listing any factors we had identified from the literature. This was so that we would not bias participants' responses to those identified factors. However, we also wanted to get a sense which factors were most prevalent, and if participants' answers would change after seeing a list of factors from the literature.

We solicited participants from the SIGCSE mailing list, the CSEd-research list, the cssei-interest list, the Facebook group on CS education, the reddit community on CS education, and

on Twitter. We asked participants to share the survey with their colleagues. A total of 87 responses were collected, 78 of whom were completed, and with 53 answering every question. For our qualitative analysis we only used the 78 complete submissions.

Respondents came from a total of 65 different institutions, 51 of which had only one respondent. 3 institutions had two respondents; two had four respondents; and one institution had five. We had no participants from our own institution.

III. Results

In the open-ended questions, we found eight approaches used by CS departments to handle the enrolment boom. In order from most common to least common (as indicated by the number of participants who mentioned it):

1) **Altering course offerings (39):** increasing class sizes, more sections, reducing elective offerings, etc.
2) **Hiring (28):** faculty, contingent faculty, TAs, etc.
3) **Gatekeeping of classes (8):** restricting access to classes by programme, directing non-majors to other classes, "weeding out" students, etc.
4) **Course delivery changes (4):** using flipped classes, using more web exercises, more autograding, etc.
5) **Gatekeeping of major (3):** increasing existing thresholds to enter major or creating such thresholds, etc.
6) **Faculty management (3):** teaching overloads, changing credit for teaching, etc
7) **Space (3):** acquiring new classrooms, moving to larger buildings, etc.
8) **Other programmes (2):** creating partner degrees (e.g. data science), increasing graduate programmes, etc.

Only one participant made any mention of diversity in the open-ended questions on page 3: *"We are asking for new tenure lines and hiring multiple visitors. Not much else we can do without harming enrolment of women and underrepresented minorities."* (P57)

After priming, five participants mentioned the diversity issue, saying either that it was being neglected or that it was an important issue. For example: *"I've recently been considering the impact of "weed out" classes on diversity in the major, and that may become more of an issue as enrolments increase, incoming student quality potentially declines, and the use of weed out courses as a tool for enrolment management gains more consideration. This issue has not been explicitly considered in the past, but I will be keeping it in mind."* (P20)

With regard to the factors we had explicitly asked about, they were ranked:

1) **Most commonly a "major factor":** Classroom capacity, Fiscal resources, Quality of undergraduate education, Faculty/staff availability and/or workloads, Use of contract/sessional/adjunct instructors and teaching assistants
2) **Most commonly a "medium factor":** Effects on student culture and experience, Quality of students, Political support/opposition from outside the department, What has/hasn't worked in the past
3) **Most commonly a "minor factor":** A sense of urgency, University/government requirements and regulations, *Demographic diversity of student body*, Capacity to teach non-CS students, Influential or outspoken individuals, Feedback from students, Ability to provide interdisciplinary courses/programmes, What other institutions are doing
4) **Most commonly "not a factor":** Political support/opposition within the department, The education research literature

IV. Discussion

Our results indicate that diversity is considered a minor issue to CS departments when it comes to handling the current enrolment boom. More positively, the related factors of "Effects on student culture and experience" and "What has/hasn't worked in the past" were ranked most commonly as medium factors. However, "Quality of students" was also listed as a medium factor, and could indicate that gatekeeping is a higher priority for some departments.

Perhaps more troubling than the low ranking of diversity was that "The education research literature" was most commonly ranked as "not a factor".

Because we recruited participants from CS education communities, our participants are not likely to be representative of all university CS educators. However, our participants are thought to be *more* likely to care about diversity and classroom culture than faculty who are not members of CS education communities. Our study likely gives an upper bound on how much diversity is considered in enrolment boom discussions.

It is clear that more needs to be done to convince CS department policymakers to consider diversity in how they manage their enrolments.

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