

Computing to Change the World for the Better: A Research-Focused Workshop for Women

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Abstract—Women’s underrepresentation in Computer Science (CS) can be attributed to various factors including lack of self-efficacy, role models, encouragement, awareness of the discipline and existing research pathways. In February 2019, we hosted a Google-sponsored research-focused workshop at California State University, Long Beach to raise female undergraduates’ awareness and confidence in CS research pathways and careers. Forty-six students from several universities in Southern California participated in the workshop. Over the course of three days, students worked on research problems with clear real-world applications in teams led by faculty and assisted by graduate students. Additional sessions were held to inspire female undergraduates, increase their confidence and enrich their knowledge about research and graduate programs. In this paper, we report about our experience and the lessons we learned. We also present evidence of success in strengthening the research interests of our participants based on the results of the pre- and post-surveys that were designed and administered by the evaluators of our funding agency (Google Inc.) to better understand the impact of these workshops.

Keywords— *Recruitment and Retention, Broadening of Participation, Equity and Inclusion, Research-Focused Workshop*

I. INTRODUCTION

Scientific breakthroughs and innovation require outside-of-the-box thinking, which can be fostered by diversity and gender equity [1, 2]. Nevertheless, women’s underrepresentation in Computer Science (CS) and their considerable higher attrition rate, not due to lack of ability or lower grades, have been well documented [3-5]. Various factors can contribute to this underrepresentation including (but not limited to): stereotype threat, a lack of sense of belonging or having a community, lack of role models and encouragement, pedagogical issues, and problems with work-life balance that disproportionately affect women [6, 7]. All these factors have varying ramifications and implications for the corresponding interventions [8].

Per 2018 Taulbee survey—conducted annually by the Computing Research Association—women comprised only

22.3% of the CS doctoral enrollment and 19.3% of CS doctoral graduates in academic year 2017-2018 [9]. This gender disparity at the doctoral program level would continue into research careers or senior high-tech positions. Thus, encouraging more women to pursue research careers and advocating their advancement into senior tech roles and CS field leaders should be of high priority. Studies have shown that prior research experience at the undergraduate level can promote pursuing doctoral program and research careers instead of going directly to industry after graduation [10, 11]. Recently, CS Research-focused workshops have shown to be effective in raising awareness and confidence in CS research and its career pathways for undergraduates [12, 13]. They also improve students’ retention in the major and their ability to work independently and to communicate well with a team. These benefits are of particular importance for minorities in computing (including women) who are more likely to see research careers as “not for them” because of the lack of role models or encouragement to pursue research careers and pathway.

Leveraging on our institution’s diverse body of students (in terms of ethnicity and socioeconomic factors) and its prime location in Southern California, a research-focused workshop for undergraduate women from Southern California was hosted at California State University, Long Beach (CSULB)—in partnership with two other regional institutions: University of California, Irvine (UCI) and University of California (UCSD). The workshop was funded by Google ExploreCSR program [14]. In the following sections, we explain in detail the workshop goals and structure, assessment results and lessons learned.

II. WORKSHOP GOALS AND STRUCTURE

We designed, developed and hosted a three-day regional research-focused workshop for undergraduates to work on research problems in teams consisting of 6 undergrads—each led by a faculty from CSULB, UCI or UCSD and assisted by 2-3 of their graduate students (majority Ph.D. students). Inclusion of graduate students was also intended to provide an opportunity for the undergrads to network with them and

This work was supported by Google’s ExploreCSR program.

learn firsthand about graduate student life and pathways. CSULB is a Masters-granting university, however we have a limited joint PhD program in Engineering and computer science with Claremont graduate university. Due to this limitation, most PhD students who performed as project mentors were from UCI and UCSD. Our main goal for the workshop—aligned with those of the Google’s ExploreCSR program— was to enhance the undergraduate research experience and increase women’s motivation to pursue graduate study and research careers in CS. More specifically, the workshop aimed to achieve the following:

- **Community:** Foster a sense of community and support from peer groups and both near-peer and faculty mentors.
- **Skills:** Provide practical skills and know-how to help women succeed both in their undergraduate program and beyond.
- **Confidence:** Instill confidence that comes from knowing women have the skills to contribute to problem solving beyond the classroom.
- **Motivation:** Motivate, inspire and challenge women through exposure to real-world research problems in computer science.

Studies have shown that in contrast to men, women contextualize their interest in computer science within a larger purpose [15]: How can they change the world for the better? In fact, many females would like to learn how to employ computing within a broader context of education, communication, medicine, art and music [16]. Based on this observation, for the workshop, we planned to have carefully designed multi-disciplinary and practical projects with clear real-world applications. Brief descriptions of workshop research projects, spanning a wide variety of topics, are included on the workshop website [17]. To have an intense and authentic research experience, the workshop schedule was framed around total of 10 hours workshop sessions, spread out over three days, where the students learned how to tackle a real-world group project by formulating relevant research questions, proposing various approaches for the solution, analyzing them and collecting evidence while considering the problem’s limitations. The scope of the projects was designed in a fashion that the group effort was sustainable over all three days. On the last day of the workshop, during a two-hour session, each team (including all its undergrad team members) gave an oral presentation to workshop participants about their projects results.

Furthermore, we held 3 one-hour plenary panel sessions, where PhD. students talked about their main motivations to attend a PhD program and shared their personal stories including challenges they confronted and ways they overcame these challenges. Several other topics of importance (e.g. imposter syndrome, life-work balance, research ethics and gender bias in the workplace) were also discussed. Having these open and honest conversations in a friendly and safe environment were aimed at providing clarity and context about life of a CS researcher to the undergraduate participants.

Another session was allocated to graduate school application process where the undergraduate students learned how to make a successful Ph.D. application package including C.V., personal statement, letter of recommendation or how to prepare for the GRE exam. In addition, information about various available funding opportunities for the financial support of a Ph.D. student were presented.

Finally, we invited three successful female computer scientists as keynote speakers (one from academia, two from industry) to talk about their research work, personal/professional journey and the importance of diversity in CS workplace. The students had opportunities to interact one-on-one or in small group discussions with the speakers at the end of their presentations. We believe that having direct interaction with these successful female computer scientists (potential future role models) and seeking their advice can play an important role in encouraging the female undergrads and increasing their resilience in the field.

III. IMPLEMENTATION OF THE WORKSHOP

Logistical planning for the workshop started 6 months in advance (on August 2018). The workshop website was designed and went live at the end of October 2018. We prepared some workshop flyers that included general information about its learning objective, date, location, and the targeted participants. To be inclusive, we mentioned that while we welcome applications from female undergraduates, male students can also apply, and that preference will be given to first-generation students and those from groups underrepresented in computing. As advertisement, we sent emails to CS department Chairs and undergraduate advisors of 10 regional universities in southern California attaching the flyer and asking them to share the information about our workshop with their students. A simple application form was created on the website to collect general information (demographic and a brief statement on their interest in CS and their goal for workshop participation) about those interested in participating at the workshop.

We received total of 110 applications by mid-December 2018. A rubric was developed to evaluate the applications mainly based on the applicants’ statements of purpose while giving preference to minorities in CS (in terms of gender, ethnicity or socioeconomics). Each application was reviewed separately by two faculty using the developed rubric. If the two scores assigned to an application had large discrepancy, the case was discussed in detail among the faculty to resolve the discrepancy (if possible). Then all applications were sorted based on their average scores. Our targeted number of participants was 70 students. Thus, we notified the top 85 applicants of their acceptance to register for the workshop. The registration fee was kept at \$50 to guarantee registrants’ attendance. However, we let the accepted applicants know that we would waive the fee for those who are serious about attending but cannot afford to pay (self-declare). As a result, the fee was waived for 5 registrants. Accommodation at a local hotel was provided to those students who were living more than 50 miles away from CSULB campus. The workshop also provided 3 meals a day for the workshop participants. In terms of transportation, we helped those

students who were interested in carpooling to find a joint ride to the workshop venue. Paid parking was provided to the participants over 3 days of the workshop. Out of 85 accepted applicants, 54 of them registered for the workshop by the end of January 2019. The list of research project leaders and their descriptions were finalized on the workshop website and the registrants were asked to rank their projects selection by mid-February 2019. Each student was then assigned to one of their top 3 selected projects in a team of 6 students per project.

At the end, 46 undergraduate students, 17 graduate students and 9 project leaders (faculty) participated in our three-day workshop. They worked on their projects, presented their results and received a certificate acknowledging their efforts and participation (Fig.1)



Fig. 1 Dr. Moon from CSULB and his team members received certificates for completion of the project: “Where is Hollywood?: An artificial intelligence approach.”. This project was the most popular one based on the students’ responses on a workshop preparation survey.

A majority of the faculty (56%) and graduate students (82%) involved with the workshop were women to facilitate creating a sense of belonging and community among the female undergrad participants (93%). Fig. 2 presents the demographic information of the undergrads in terms of ethnicity and university they were attending. With respect to socioeconomic factors, 43% of our participants were first generation. These numbers demonstrate the diverse body of the workshop participants.40% of the undergraduate students were Freshman or Sophomore.

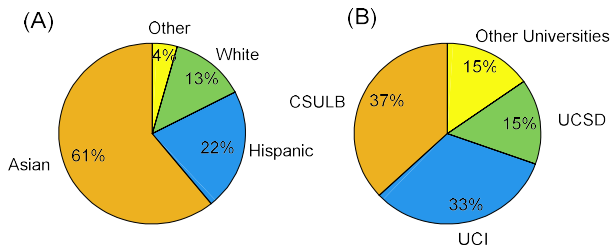


Fig.2 Demographic information of the workshop participants: (A) Ethnicity; (B) University

IV. WORKSHOP EFFICACY ASSESSMENT

The workshop efficacy assessment plan was designed [18] and implemented by independent evaluators of Google’s ExploreCSR program. A mixed methods approach was

employed to evaluate each workshop via surveys and interviews conducted with workshop participants using the four key aims discussed in section II. Self-efficacy and attitudes about computing have been shown to correlate with academic retention in computing disciplines for all students [19], and specially for women [20]. Thus, the survey and interviews focused on these overarching indicators of the ExploreCSR program success for women in computing research: student perceptions of the research experience (self-efficacy, attitudes towards computing, mentoring), skill development (research), and career identity (intent to pursue graduate school, scientific leadership and identity). These surveys were approved by Intuitional Review board (IRB).

Pre- and post-surveys were administered prior to the start and at the end of the workshop via a Qualtrics survey link, distributed directly to the students. Workshop observations were conducted when possible, and where applicable interviews were conducted of student participants. The surveys measured: (A) Self-Efficacy, (B) Interest in Graduate School, (C) Attitudes about Computer Science, (D) Research Skills, (E) Professional Identity, (F) Sense of Belonging, (G) Grit, (H) Teamwork/Leadership, (I) Mindset, and (J) Peer Relationships. Items were rated on a 5-point Likert type scale, with 5 being most positive rating. Fig. 3 summarizes the responses from 43 and 35 students that completed the pre-/post-surveys, respectively. We observe that all constructs increased at post-survey except for (C) Attitudes about Computer Science. One possible explanation is that since the students self-selected to attend the workshop, they might have been already predisposed on their attitude about CS. sing an independent sample t-test indicated that the increase of (D) Research Skills and (E) Professional Identity have been statistically significant with both p-values<0.01.

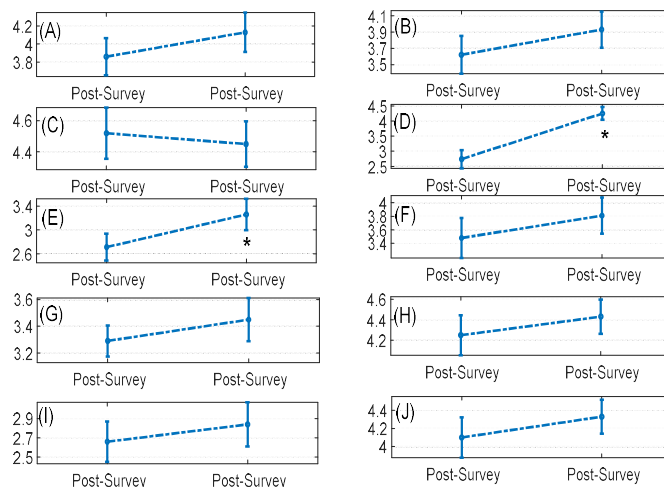


Fig. 3 Mean and 95% confidence intervals of the scores (on a 5-point scale) of pre-survey and post-survey results: (A) Self-Efficacy, (B) Interest in Graduate School, (C) Attitudes about Computer Science, (D) Research Skills, (E) Professional Identity, (F) Sense of Belonging, (G) Grit, (HI) Teamwork/Leadership, (I) Mindset, and (J) Peer Relationships. *indicates significant difference with p-value<0.01.

Additional findings from the ethnographic observation and qualitative interviews include:

- Students gained extensive research experience and believed that their workshop mentors promoted critical thinking and reasoning skills.
- Mentors created a culture of intellectual curiosity.
- A strong sense of community and belongingness was developed.
- Students learned about how to apply to graduate school, which was very beneficial for them as they plan out their career goals and aspirations post-graduation.

V. RECOMMENDATIONS BASED ON THE LESSONS LEARNED

In order to help with identification of key components of our workshop that can be scaled to transfer to other schools, here we also share some of the lessons we learned from our experience that might improve the workshop outcomes by others who organize similar workshops:

Enhancement of participation: Around 37% of our accepted applicants did not register for the workshop. This was mainly due to the timing of the workshop which happened to have coincidence with midterm exam week in some of the regional universities. 15% of our registrants also changed their mind about attending. However, this ratio is consistent with those reported in [12]. The majority of our attendees were from the universities whose faculty were among the project leaders. Thus, in a case of multi-institutional workshop, involvement of at least one faculty from each institution can enhance the students' confidence and trust in the workshop and consequently increase their attendance. Reimbursement of the registration fee to those who attend the workshop might be another effective strategy to decrease the last-minute dropouts.

Pre- and Post-survey: While 94% of our attendees completed the pre-survey (mainly during the workshop registration on the first day), only 76% completed the post-survey as it became available few days after the workshop. Incentivizing strategies (e.g., gift cards) might have helped in recruiting a larger number of students in completing the post survey.

Research projects: Evaluating students' responses on the project preference survey, we noticed that simple, practical and relatable projects were more popular among the students. Early announcement of the project descriptions and their leader faculty can help both students and the workshop organizing committee to make a better-informed decision about the project selection.

VI. CONCLUSION

Our workshop engaged a regional cohort of undergraduate women in an inclusive computing research learning environment. The attendees were able to enhance their research skills and professional identity significantly. A strong sense of community was developed, and students were encouraged and guided to continue their education to a Ph.D. program.

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