

# Complementing National Retention Efforts in Computer Science with Local Support

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**Abstract—** Within the past 20 years, there have been numerous national interventions for graduate students from underrepresented groups in computer science. Local programs leverage and complement national resources while providing local support within students' home departments. In this cohort-based program, selected scholars receive scholarships. The programming combats five barriers faced by Ph.D. students. This paper argues for a local and national approach that will significantly improve retention over a purely national strategy.

## I. INTRODUCTION

It is widely known that computer science, as a discipline, has faced recruitment and retention challenges, for women and students of color, at the undergraduate and graduate levels. Numerous interventions have been created; however, despite creating national programs to encourage the positive progress of computer science doctoral recipients, Ph.D. production has remained stagnant since 2007. These national programs have evidence of success; however, students who go through the program often need more focused support once they return to their home institutions. In addition, they need tailored advice specific to the culture, norms, and expectations of their home institution and department.

Local programs take a personalized approach to support doctoral students in CS, by providing tailored, specialized support to overcome barriers, thus improving student outcomes. We believe that the synergy of national and local support is essential to drastically improve outcomes for CS doctoral students.

## II. BACKGROUND

### A. Prohibiting Factors

Research shows that several factors prohibit Ph.D. students from completing degree programs:

#### 1) Growing Financial Concerns

Over the last ten years, the cost of college has far outpaced growth in incomes and the average level of unmet need for graduate students is rising [1, 2]. This trend disproportionately affects students from low-income households. In addition, this effect disproportionately affects students from racial groups that are underrepresented in STEM.

#### 2) Unclear Expectations

Apart from coursework requirements, qualifying exams, and a dissertation defense, the expectations for graduate programs are largely unarticulated. Gattton refers to this as the “unwritten curriculum” that students are expected to learn [3].

#### 3) Partial Mentoring/Advisement

Inadequate advice hinders students from pursuing PhDs in STEM fields. With bad advising, students lack awareness of the advantages of obtaining a Ph.D. [4].

#### 4) Unequal Socialization into the research community

While research stresses the importance of deliberate socialization efforts, research also indicates that students do not receive equal socialization opportunities (faculty interactions, support resources, interaction with other students, etc.) in graduate school as compared to their higher- SES peers [5].

#### 5) Adverse Psychological Effects

Students often face psychological barriers because of foundational cultural practices that guide how institutions function. Stephens [6] states that higher education institutions are “built and organized according to taken for granted, middle- and upper-class cultural norms, unwritten codes, or “rules of the game””. As a result, students may experience difficulties with emotional challenges, identity management, self-perception, and motivation [7].

### B. Interventions

Many national professional development opportunities for graduate students in computing are supported by funding from NSF Broadening Participation in Computing (NSF) programs and even NSF-wide programs. Prior and existing graduate student programs, many of which focus specifically on supporting computing graduate students include: NSF Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES), The Alliances for Graduate Education and the Professoriate (AGEP), The Louis Stokes Alliance for Minority Participation (LSAMP), STARS BPC Research Scholars, The STARS Computing Corps, The Institute for African American Mentoring in Computing Sciences (iAAMCS), blackcomputeHER Fellows Program, diversity in computing conferences, and industry fellowships.

The aforementioned activities primarily focus on graduate student support. However, these engagements are typically one-time or short-term supports.

### C. *The Case for Local Support*

There is a great need for local support structures that (1) provide more specific, tailored advice rather than general, (2) clarify local/program-specific expectations for obtaining a Ph.D. at the student's institution, (3) build closer connections and relationships locally. While there are often programs offered by graduate schools, there aren't many department-level graduate supports for students as they matriculate through their Ph.D. milestones as most of the funding and programming are focused on recruiting students to graduate school.

## III. LOCAL SUPPORT STRUCTURE

Administering local support needs to be at the department level to effectively provide opportunities for community building, mentorship, academic and professional development, demographic identity support, and faculty development that support the eclectic students enrolled in our degree programs.

### A. *Community Building*

One model for local program support is a formal cohort model composed of students entering the program in the same year. The cohort model explicitly addresses both the psychological needs of students by fostering a community of peers and unmet advising needs. This design provides opportunities for scholars to get to know each other and foster genuine connections to each other by providing opportunities for scholars to attend events and matriculate together.

### B. *Academic and Professional Development*

Local programs provide internal and external academic and professional development. Internally, to enhance classroom and lab knowledge, monthly workshops are held throughout each semester. A combination of department faculty and guest speakers can cover important topics during monthly seminars customized to their academic standing. Department-level programs can leverage existing academic and professional development programs offered by the university. Monthly cohort seminars are supplemented by a monthly discussion session that follows the external workshops to answer questions and contextualize the content within the department. Externally, scholars can be encouraged to participate in academic conferences related to their specific research area.

### C. *Demographic Identity Support*

From prior experience, it has been observed that students' experiences can often be affected by intersectionality. As such, students should be encouraged to participate in national and local programming specific to their identities. In addition, identity affinity groups need to be provided locally to help them grapple with intersectional identity experiences and advise scholars on navigating various contexts with this identity.

### D. *Faculty Development*

Faculty development is a much larger task of the university to prepare and support faculty as they work with graduate students of differing demographics. In the events following

George Floyd's murder, universities and departments across the country have doubled down on engaging faculty and students in discussions about race, ethnicity, gender, diversity, equity, and inclusion. Such interventions, if sustained, will help faculty to meet the needs of diverse students enrolled in Ph.D. programs.

## IV. CONCLUSION

Graduate student success is personally significant for each of our students; corporately to the enterprise of academia in both student retention and productivity. We believe that combining support provided by national programs with local backing gives the most beneficial outcome for student success. National programs expand students' networks, increase socialization, provide a global context for the research and the academic community, and provide solidarity in numbers. Local programs provide targeted disciplinary contextually accurate advice for students, give a closer-knit group of people to build community, contextualize local expectations regularly, meet unmet advising needs, and provide more consistent mentorship.

To grow the number of local programs that support student success, several structural barriers need to be addressed: (1) Funding - Faculty need to apply for more opportunities to provide scholarships for students and support continued scholarly research of graduate support programs. (2) Departmental infrastructure for scaffolding students' professional and academic development beyond technical courses through offering a 1-credit course each semester for interested faculty to teach these kinds of things. (3) Training for faculty to help them better understand students' needs and reveal the hidden curriculum more transparently. (4) Promotion and Tenure Evaluation criteria need to be revised to include value for this kind of work on par with other research successes not to be viewed as "charity work", but as a valued investment in the next generation of leaders.

## REFERENCES

- [1] Danielle Kurtzleben. Charts: Just how fast has college tuition grown?, Oct 2013.
- [2] College Completion Plan 2012 - A University-wide Plan for Student Success The Implementation of Goal 1 of the GSU Strategic Plan. 2012.
- [3] Gaston, J. L. (2004). Preparing for the professoriate: What African American graduate students should know. A long way to go: Conversations about race by African American faculty and graduate students, 32-40.
- [4] Marian E Brazziel and William F Brazziel. Factors in decisions of underrepresented minorities to forego science and engineering doctoral study: A pilot study. *Journal of Science Education and Technology*, 10(3):273-281, 2001.
- [5] Jualynne E Dodson, Beronda L Montgomery, and Lesley J Brown. Take the fifth: Mentoring students whose cultural communities were not historically structured into US higher education. *Innovative Higher Education*, 34(3):185-199, 2009.
- [6] Nicole M Stephens, Stephanie A Fryberg, Hazel Rose Markus, Camille S Johnson, and Rebecca Covarrubias. Unseen disadvantage: how American universities' focus on independence undermines the academic performance of first-generation college students. *Journal of personality and social psychology*, 102(6):1178, 2012.
- [7] Micka'el Jury, Annique Smeding, Nicole M Stephens, Jessica E Nelson, Cristina Aelenei, and Celine Damon. The experience of low-SES students in higher education: Psychological barriers to success and interventions to reduce social-class inequality. *Journal of Social Issues*, 73(1):23-41, 2017.