Addressing Gender Disparities in Computing Majors and Careers: Development and Effects of a Community Support Structure

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1 Introduction

It is no secret that computing fields have a diversity challenge. In 2016, 57% of bachelor's degree recipients were female; however, only 19% of computer and information science bachelor's degrees were earned by females. This gender gap in computer science education also translates into the professional world where women hold 57% of professional occupations, and less than 25% of computing professions [1]. With numerous reasons cited, including stereotypes of the field, a lack of role models [7], and a desire to help others, attracting and retaining women in the field is challenging; yet, it is crucial to push the discipline forward.

The Duke Technology Scholars program, which began in 2016, aims to address the female disparity in computing fields through a focus on women in their undergraduate years who have declared computer science and/or electrical and computer engineering majors. The program prioritizes peer-to-peer relationships, career mentorship, strategic coaching, and hands-on experience to recruit and retain such individuals in technology fields. In this paper, we further discuss the particulars of the program, distinguish it from other programs discussed in the literature, as well as present evaluation processes and findings from a mixed-methods study focused on activities from the 2018-2019 cohort. Our evaluation includes program administrative data, baseline and post-program survey data from three program sites and focus group data. We concentrate on the effect of program activities on educational and career trajectories of women in computing, as well as methodological strategies used. As our data depict, this program had clear and positive effects on participants' self-efficacy, interpersonal and professional skills, mentor relationships, and exposure to career opportunities.

We begin by providing literature foundational to the theory of change for the program in order to situate the evaluation project within the context of the overall program. Then, we review the evaluation focus, including specific research questions and the methodology used. Finally, we discuss specific findings, and offer insights into future directions for next steps in overall program development and evaluation.

2 Program Description

Before we discuss the literature supporting the program design, we first describe the Duke Technology Scholars program (DTech) community support structure which includes year-round coaching, on-campus programming, summer living learning communities, industry mentorship, internship matching, and immersion in a network of peers (Figure 1). Founded in 2016, the program created and housed at Duke University is funded by individual and corporate donations. The coaching staff are employees of the university and are based in Durham, North Carolina (N=2) and the San Francisco Bay Area (N=1). The staff assists students who are computer science and electrical & computer engineering majors in securing a tech-based internship (typically in software engineering or related computing field) in one of three hub cities: Silicon Valley, CA; Chicago, IL; and Research Triangle Park, NC.

The DTech program begins in September when an application opens for students. Any student may apply to the program. There is no screening or special requirement for applying other than

having declared the target majors and being a student at the university. This application includes a student's preferences for job functions, industries, and location. Students also indicate their technical skills and have an opportunity to express both coursework and co-curricular activities that have helped them obtain relevant job skills. Once they have applied, students are required to attend information sessions which provide opportunities to gain more insight into the program itself, meet the staff, and meet students who have previously completed a summer internship through the program. Next, the coaching staff uses this information and work directly with companies who have been interviewed for their needs, to send resume books of a small set of students who match the company's requirements. Once students have obtained an invitation to interview with a company, they receive individualized coaching by the staff through resume reviews, interviewing tips, and negotiation strategies.

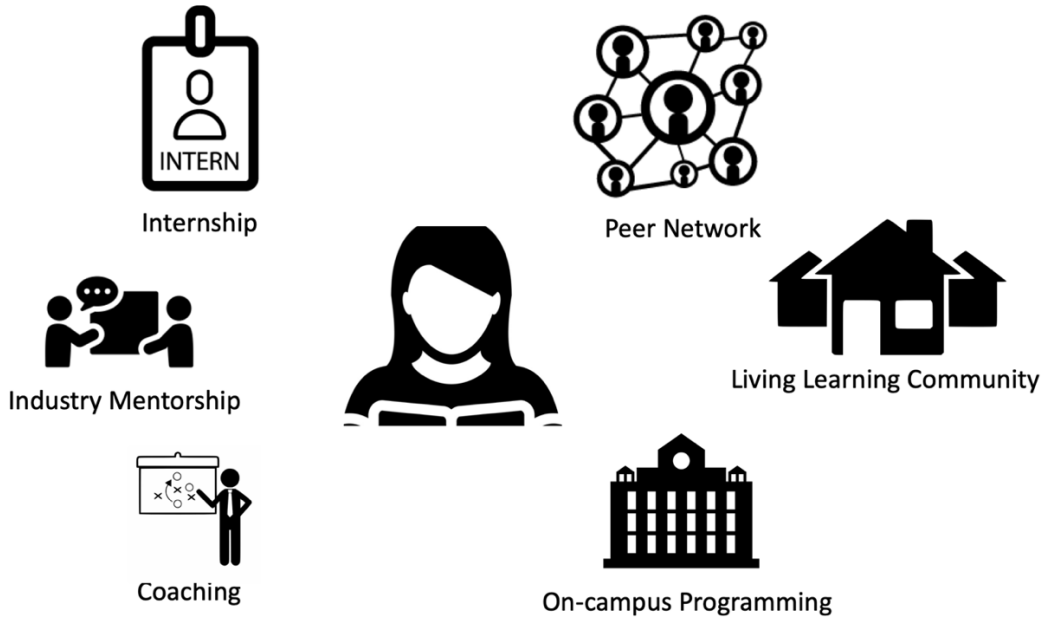

Figure 1. Community support structure which includes an internship, access to a network of peers, a summer living learning community, on-campus programming, end-to-end strategic coaching, and matching with industry mentors.

Once students obtain an internship (either by their own search or through opportunities announced by program staff) in a hub city, they become "Scholars" of the program. Scholar status secures a spot in housing within apartments/houses reserved by program staff and paid for by the program itself. Student salaries are paid for by the companies, and their other expenses are paid for using their income earned. Scholars are involved in a series of events during the spring designed to bolster their success including meetups and a day-long leadership program for scholars consists of panels, keynotes, and activities designed to prepare them for the summer.

During the summer each city-based cohort has a variety of networking, professional development, cultural, and social events designed to facilitate exposure to professional opportunities. Sometimes these events are planned remotely and attended by student cohorts, other times, coaching staff will attend the events with students. Each student is also matched with a mentor who is currently in the tech industry and has been found by the coaching staff.

There is no formal training for these mentors, and each pairing navigates the particulars of working together for the summer. The program requests that the mentor-mentee pair attempt to meet every other week; however, this is not required. Students also typically informally mentor each other when returning home while talking through their experiences and challenges in the job environment. These spontaneous conversations are supplemented by a weekly discussion led by a house leader, highlighting a success or something positive (e.g., "roses and thorns") during the week, a challenge experienced, and an experience to which to look forward. Finally, the coaching staff continues to be available for questions during the summer either through video conferencing or in person depending on student locations.

3 Literature Review

The Duke Technology Scholars program is rooted in research-based findings that mentorship, tightly bound communities, and internships are key to supporting women in not only thriving in computing-related fields, but also choosing to persist in careers once they graduate. Further, we distinguish our approach from others by adding personalized coaching and a constellation of mentors as elements that support the success of our Scholars.

3.1 Mentoring

Mentoring is traditionally a relationship in which an experienced person provides technical, career, and psychosocial support to a less experienced person [1]–[3]. Technical insights might include problem-solving, approaching internships/jobs, interacting with faculty members, or learning the unwritten rules of an organization. Career-related functions could include sponsorship, supporting visibility, providing ideas, feedback and suggestions, and protection against risks [4]. Additionally, psychosocial issues might include work-life balance, responding to discrimination, being confident, coping with disappointment, or growing as a person. Regarding engineering, a number of studies have shown the benefit of mentors and instilling a sense of belongingness, especially for underrepresented populations in the community[5]–[8]. These benefits include increased graduation rates, enhanced self-esteem, building a professional network, improving communication skills, and gaining clarity on academic, personal and career plans.

Most mentoring programs rely on one-to-one models where students are matched with faculty, graduate students, industry, alumni, more senior-level undergraduate students, or others to support mentees. This one-to-one model might not be the best fit for women and minority students [1]. To escape barriers presented by a one-to-one model, we build upon the seminal work of Kram and Isabella [3] and others who suggest that multiple mentoring relationships can best support student trajectories. In this work, mentoring constellations both simultaneously and successively support one's development [9], [10].

Specific to our program, we employ the notion of a constellation of mentors through peer-to-peer networks, student-industry partners, and staff coaches. Peer-to-peer mentoring occurs somewhat organically through the summer living learning communities, but also during the academic year events such as dinners and other social as well as student panels. During the summer, students are matched with industry mentors who provide support while they are on the job, and sometimes after the summer. Finally, program staff are extremely "high touch" in the sense that they provide individualized coaching for student journeys as they look for jobs, go on the

interview circuit, and negotiate. Beyond that, the staff coordinates programmatic summer activities to supplement their internships and continue to build community.

3.2 Living Learning Communities

Although the DTech program does not consist of an on-campus living-learning community, the approach to supporting students living together while at internships not only supports their experience while away from the university, but also forms bonds that continue in the academic year. As a result, we briefly discuss living-learning communities. Typically, living learning communities are focused on on-campus facilities that group students in a discrete portion of a college residential hall, offer participants a common academic experience, involve co-curricular activities, and provide unique resources to its participants [11]. A core characteristic of these communities is engagement of students both socially and academically, and research suggests that LLCs support a sense of community for students. This sense of community has been linked to beneficial results for students such as engagement in class activity, enhanced self-efficacy, persistence, and better academic performance [12], [13].

3.3 Student Internships

Internships in the context of this program are off-campus learning experiences that provide students with an opportunity to learn about computer science and engineering professions through observation and participation at a job site. Further, these jobs take place during the summer, and involves full-time, paid work with a variety of companies. Internships and cooperative opportunities (although the latter are not discussed in this paper) have long been lauded as a meaningful practice for increasing student retention in computer science and engineering [14]. In fact, some research has found that a single internship experience can sometimes mean the difference between taking a job after graduation or choosing another field [15]. Generally, these experiences are representative of what a student might be doing in the field as they learn the various tools, practices, and workflows of industry. Beyond hands-on practice in the field, in a 2013 study, Samuelson and Litzler found that internships can increase student learning as well enhance their professional networks which led to greater confidence in career fit [16].

4 Methods

Key questions addressed both process and outcome evaluation, as both were central to program interests. Evaluation questions included: (1) How do Scholar participants experience/engage with the program and its components? and (2) To what degree does the program affect Scholar participants in anticipated short-term outcomes (i.e., improved network, self-efficacy, professional skill development, career clarification)? Although the program has been in existence since 2016, we have only collected data through an external evaluator for the 2018-19 academic year. As a result, we restrict our findings to these data.

4.1 Participants

For the 2018-19 program, out of 185 applicants to the program, there were 64 women who became Scholars working at 32 different companies. Of these, twenty-seven were rising seniors, thirty-three were rising juniors, and four were rising sophomores all at the same university. With respect to race, 21% were White, 44% were Asian, 18% were African American, 13% were Hispanic (Non-White), and 4% were two or more races. All students were computer science

and/or electrical engineering majors. Participants were distributed across three sites: Silicon Valley (n =34), Research Triangle Park (n = 19), and Chicago (n = 11). They were grouped in houses or apartments based on internship location at each site. We did not collect socioeconomic data.

Table 1. Program participants

Category	N	%
Graduation Year		
2019 (Rising seniors)	27	42%
2020 (Rising Juniors)	33	52%
2021 (Rising Sophomores)	4	6%
Program Site		
Chicago	11	17%
Research Triangle Park	19	30%
Silicon Valley	34	53%

4.2 Measures

Evaluation processes included a pre- and post-program survey and focus groups which were stratified by city-based cohorts. Survey assessment was administered prior to students leaving for the summer, and the post-program survey was administered on a rolling basis, as Scholars completed their internships (this occurred between July and August 2018). All surveys were administered electronically through Qualtrics, and participants completed the surveys on their own time. In total, 52 Scholars completed the pre-survey, 49 completed the post-survey, and 44 completed both (68% response rate both pre and post assessments, based on n=64 summer program completers).

Outcome measures were based upon the program theory of change and included multi-item scales for general self-efficacy/perseverance; computer science/engineering self-efficacy in an applied setting; teamwork, leadership, and communication skills (in both academic and applied settings); and mentoring and peer relationships. In addition, the post-program questions also addressed confidence and skills related to finding and obtaining employment, as well as open-ended qualitative questions about program experience and outcomes. Where available and aligned with intended program outcomes, we utilized validated instruments in this survey design [17]–[22] .

To further understand participant experience and facilitators of program-based outcomes, evaluators conducted qualitative data collection with Scholars. All 2018 Scholars were invited to participate in the focus groups, with participation ultimately based on respondent interest and availability. The focus groups were conducted in September (Chicago, RTP) and November

(Silicon Valley), 2018. Each group included 3-7 participants for a total of 14 study participants. This process was not designed to yield a representative sample of participants; rather, it was primarily intended to give greater insight into findings from survey-based data.

4.3 Data Analysis

For analysis, evaluators aggregated individual survey items to create measures for key outcome constructs, with factor analysis used to consider the alpha scores for summary scales. Outcome data was analyzed in SAS using descriptive statistics, paired *t*-tests, and effect size calculations to compare changes from pre-program to post-program, and regression models were used to account for program site. Evaluators also analyzed responses to open-ended questions using the coding schema developed for the focus group component, as described below.

For analysis of focus group data, the audio recordings were transcribed and qualitative data analysis software (NVivo) was used to code data. An initial coding schema was based upon the logic model framework. Analysis focused on identifying key themes related to the main evaluation questions, including an iterative process of coding schema refinement drawing from both pre-identified constructs (e.g., core program elements, primary intended outcomes) and emerging qualitative data. Interpretation included attention to frequency of reference to key themes among participants as well as cross-tabulations to examine differences between program sites.

5 Findings

The findings discussed below are separated into two categories: program experience (PE), and participant outcomes (PO).

5.1 (PE) Community Experience

Co-housing and associated peer support proved foundational and integral to the student experience. Within their housing units, participants turned to their peers (some they knew from campus, some they met when they moved in) for emotional support, problem-solving, and empathy with regard to their experiences in their internships. Importantly, the peer community reassured participants, “I’m not the only one thinking or feeling” a certain way. Respondents described how important it was that “if anything happened at work, or [was] challenging, you had people around you that you could talk to always.” This reduced potential feelings of isolation or frustration that participants may otherwise have experienced in their internships. Importantly, this sharing of experiences contributed both to participants’ overall positive experience in the program and to program-based gain in areas such as self-efficacy, as “it really helped you build so much confidence, like to be around the people who were going through the same thing.”

In addition, participants increased their exposure to various tech companies and distinct work cultures through hearing about their housemates’ experiences. As one respondent explained, “I got a pretty good feel for the companies that my housemates worked at just because they would talk about it so frequently…now I kind of know what it would be like to work at a super small company or a midsize company just because hearing about their day.” Another added that “I’ve had other people DTech scholars to show me that just because my company did it one way, it wasn’t standard across the industry.” This suggests that co-housing may actually contribute to participants’ exploration of opportunities at different companies or different fields simply

through conversations that occur in the shared living environment. Thus, and despite reporting of some typical housemate tensions (sharing of space, coordinating schedules, etc.), the co-housing experience provided clear value to participants.

Beyond providing essential peer support, co-housing provided through DTech offered financial support that served as a core facilitator to participants' internship engagement. Some participants explicitly stated that their internship would not have been financially feasible without the peer housing provided by the program ("The cost of living is the greatest barrier to gaining access to this area…and the jobs and opportunities here, thus having my living arrangements taken care of for me was incredibly valuable"). For others, the location of housing sites encouraged them to pursue internships in an area that they would not otherwise have considered, due to general unfamiliarity ("I'd never been to the Bay area, I probably wouldn't have ended up there if I didn't join DTech"). While some participants may not have required this financial support, it can also permit an economically diverse participant base. As mentioned previously, however, we did not collect socioeconomic demographic data.

While respondents highly valued the role of their peer community overall, both focus group and qualitative survey data yielded insight into some variations in the co-housing experience between program sites. RTP participants more commonly found their cohort to be less communal than did other location participants, with some Scholars who "just really seemed to only be there for the internship and weren't interested in building the community." This was associated with proximity to Duke University; being near friends on campus reportedly reduced participants' inclination to rely on their roommates for social support. In contrast, the Chicago cohort cited increased bonding as a result of being together in an unfamiliar city, without other friends or family nearby: "we all had this entire new experience together to explore the city." Silicon Valley peer community experiences seemed to vary slightly based on the size of the housing unit. In some of the smaller units, finding cohesion within the group was a challenge because "there weren't necessarily always people home." Notably, Silicon Valley respondents emphasized the value of the "DTech Circles" sharing/reflection (roses and thorns) time in fostering peer community within their living community. This activity was offered but seemingly not heavily utilized in Chicago or RTP.

5.2 (PE) Internship Experience

Participants' summer internship experience, while not directly provided through the program, was integral to the students' experience of the program and served as a foundation for career exploration opportunities. Respondents particularly valued their internship experience as an opportunity to develop their computational science skills in an applied setting outside the classroom. They described how the applied context gave them an opportunity to see how the real-world application of skills they had developed at Duke ("I really needed an internship to be able to solidify those skills, validate that what I was doing was actually being used in the industry"), as well as to gain and further develop new skills ("This summer I realized I am capable of building the backend too, and now I have all the skills to prove it"). In addition, the process of problem-solving in an applied and team-based setting resonated with participants in a way that "theoretical" class assignments may not, e.g., "your company hasn't figured out how to do it, and that's why you're assigned to do it." Through these experiences of applying their skills

in new contexts, participants were challenged but ultimately developed confidence in their own abilities that they anticipate would carry over into other contexts.

Despite the overall positive experience, many participants encountered some challenges adjusting to their work environment. These included challenges finding a clear role, navigating professional relationships, and workplace culture. Many respondents reported at times not having enough work to do ("had week-long spans where I had absolutely no work. It was very frustrating and boring at times.") and/or struggling to find work on a project that was a good fit for their skills and interests ("It took me a long time to get on a project that I was interested in and that was real consistent in work"). Participants across program sites also experienced challenges navigating professional relationships, with both managers and peers. These challenges primarily centered on communication issues, where interns were initially hesitant to speak up ("I was too shy to ask my manager or the other interns questions") or were unsure how to appropriately advocate for themselves ("how to talk to my manager and be really assertive"). Ultimately, respondents reported gaining confidence in many of these situations through conversations with peers and/or staff. A smaller number of respondents, particularly those in Silicon Valley, reported challenges adjusting to the "competitive" or "male-dominated" culture of their companies.

5.3 (PE) Mentorship Experience

As mentioned previously, the program includes dedicated staff who, in addition to playing program management roles, provided guidance and mentorship to the scholars. Across data sources, this guidance emerged as central to respondents' positive experiences. This individualized support was particularly valued during the process of finding and securing an internship ("learn[ing] how to navigate through the tech world"), when program staff helped students to identify a company that was a good fit for their interests. For example, one respondent described how the staff "understood me better than I understood myself at that point… [and] found me this opportunity with a startup company."

Once participants had identified a potential internship site, staff coached them and helped boost their confidence through the internship process ("being supportive in telling me…this is something you can do"). During the summer, staff played a key role in helping participants to navigate challenging situations at work. Respondents shared how the program's Executive Director "gave me advice on how to talk to my manager" or "if there was something that I really didn't know how to navigate…she would always have really good advice about how to fix it."

Close relationships with the staff facilitated this mentorship but also posed a broader program challenge. Respondents emphasized that the "constant support and guidance" they received from the staff was unique in the level of individualized attention and close relationships that staff were able to develop with each participant ("I just feel like I can talk to them like any time about anything. So it's…professional as well as it's also more personable because you know that they always like want to support you"). Yet, given the importance of their relationships with program staff, respondents did express concern that the current intensive level of support may not be sustainable as the program grows to serve additional students. Respondents recognized that "as DTech grows, they can't be a mentor to everyone" and that it may be challenging for them to not receive "all the undivided attention" to which they had become accustomed.

While the coaching staff offered nearly universal and clear value to participants, the other mentorship program component - the formal, matched mentorship with external tech professionals – was not highly utilized by a number of respondents. This was based in part on logistical and "fit" factors, such as scheduling conflicts, distant geographic location, and differing professional interests. In addition, respondents sometimes lacked clarity about the mentorship role and appropriate expectations ("I don't really know what to do with a mentor at this point in my career...I don't know what I would even need from her at this point"), and some identified discomfort regarding the matched nature of mentorship ("[it felt] unnatural because later in our lives…it's not gonna be like you're paired or matched with some person that you wouldn't have known otherwise"). While the assigned mentor may not have served as the key support to participants, we must note that participants did not typically indicate a lack of overall personal support. As described above, participants spoke to their relationships with their peers, colleagues within their internship, and staff as key support throughout their experience.

5.4 (PE) Community-Building Experience

Beyond the peer community and internship experience, participants emphasized the importance of special events (e.g., company visits) and networking opportunities provided by the program. Respondents expanded their perspective on the range of possible career paths they might explore through visits and interaction with "different people from different companies" aside from their core internship site. They also found value in hearing about the personal experiences of individuals in the technology field ("hearing from a diverse set of career paths"), and especially the experiences of women in the tech industry. Beyond exposure, these events often served a networking purpose, as they allowed participants to make connections to leaders in the tech industry ("it's my opportunity to talk to a founder or ask them about my experiences").

The timing and frequency of special events hosted by the program, while valued as unique opportunities, at times became burdensome for participants. Many participants stated that this was their first experience with full-time employment and found it difficult to balance work, after-hours events, and the desire to maintain a social life. Echoing survey results, focus group respondents noted challenges with work-life balance, especially after a long workday, and that "having more than one event a week was really tiring." For a small number of respondents, the timing of the events was also problematic. A 6pm start time meant that they had to leave work early, which at times led to discomfort about abandoning work responsibilities ("I knew my whole team was still gonna be there for another hour and a half, probably."). However, it should be noted that not all participants shared this experience. Some Silicon Valley participants explicitly stated that striking a work/life balance was easier than during the academic year, when homework consumes a significant portion of their time in the evenings.

5.5 (PO) Self-efficacy and Professional Skills

Across data sources, we found a clear and profound increase in self-efficacy. Quantitative data showed significant increase as well as medium strength of change (as measured by Cohen's *d*) in respondents' self-efficacy in applied computational science. Many respondents indicated that they were initially unsure of how their classroom-based "theoretical" skills would translate to an applied setting and experienced general confidence challenges during their internship. However, by the end of the program, respondents demonstrated greater confidence in their skills. This was

fostered by various aspects of the program, but perhaps most notably by the peer community. By sharing their challenging experiences with each other, participants collectively gained confidence in their ability to persevere and be successful in the tech industry:

> It really helped you build so much confidence, like to be around people who were going through the same thing…were all kind of like, 'I can't do this. I have no idea what I'm doing, totally lost.' And then as the summer went, to different degrees you saw everyone achieve something, and it kind of just made you realize, 'Oh, I can do these things. They can do these things. We can all learn and fulfill our roles.'

While respondents noted gaining technical skills through their internship experience, these varied by internship and company. JavaScript was the most frequently cited hard skill gained, followed by others such as SQL and Python. Ultimately, the increase in self-efficacy that respondents experienced as a result of persevering through challenging experiences seemed to be more salient than development of specific technical skills, as it can benefit participants when encountering new and challenging situations in the future.

In addition to self-efficacy, both quantitative and qualitative analyses additionally indicated significant change, and medium-to-high strength of change, in communication and leadership skills (interpersonal skills). Over 70% of respondents reported improvement in teamwork, communication, and leadership skills in an applied setting. For many respondents, this experience was their first opportunity to work on a project team in an applied setting. Although some found navigating interpersonal dynamics challenging at first, the experience served to greatly improve their confidence in their ability to work on project teams in the tech industry ("it really helped my problem-solving skills and working with other people"). For some, this aspect of knowledge and skills gained was a pleasant, if unanticipated, outcome of participation ("I knew I would learn a lot technically (about code, design, etc.), but I also learned a lot about communication and collaboration. This was unexpected but definitely a good experience"). Although the summer internship occurred in an applied context, notably, smaller gains were also seen in these same skills in an academic setting according to survey data. This suggests that soft-skill gains in an applied setting may carry forward into the classroom.

When examining data by program site, we find that self-efficacy and soft skills gains were relatively lower (though still present) for the Silicon Valley site. In some cases, this may in part result from a participant selection bias in Silicon Valley. For instance, Silicon Valley participants on average show greater self-efficacy at the program start relative to those from the other two sites. Focus group discussions suggested that company culture in Silicon Valley may have been more competitive than other sites, and Silicon Valley companies may require interns with more experience than other sites. Thus, these higher baseline scores may reflect the type of student who desires and is selected for an internship in Silicon Valley.

5.6 (PO) Social Network Growth

Evaluation results revealed a clear growth in respondents' peer network support, which is central to the program model. Nearly two-thirds (65.9 %) of respondents reported growth in their peer support network. This included statistically significant increase in size of peer community, both

at Duke University and elsewhere. Importantly, it also included a significant increase in the diversity of interests, skills, and beliefs among those in one's peer network. Respondents indicated how those peer relationships can change their academic experience at Duke ("some of us are in classes together… now we have more people to ask questions or be in group projects with"; "have[ing] something in common with another woman in your class…makes me feel comfortable with them").

Beyond making new peer connections through the program, some participants reported a transformation in their view of what networking is and how it can be beneficial to one's professional development, as well as who comprises a professional network. This may have contributed to empirical findings of network growth, but it also speaks to a fundamental change in perspective with concrete implications for participants. For example, respondents came to value peers and coworkers as an important part of a professional network that can be useful in their future career exploration ("I see these girls as my network too…the lines between people you network with and your friends are definitely blurred"). Some who initially were wary of networking ("it's something I've always looked down on") came to realize that it's more than just "meet[ing] people for the sake of getting a job." Through the networks developed through the program, they saw how networking could be "so helpful in so many other ways. And, it's not always that you're trying to get something out of that person, but it's more like building a community where people have the chance to not only gain advice, but also share advice."

Data further showed a significant increase in reporting of having a peer who could provide valuable future education or career advice. In some cases, this was already acted upon in the months following the summer program. As one respondent described:

> I had an interview with this company that's in Durham, and right before I went to the interview… I asked the Scholar who worked there this summer all these questions about the company and what it was like. And, during the interview, it went a lot more smoothly, because I already knew what he was talking about.

This participant and others had already utilized their peer network as a resource as they continue to explore work opportunities and think about where they might pursue full-time employment after they graduate. They shared how "having an avenue to receive advice" from other participants and alumni was an asset.

Despite some challenges with the formal matched mentor provided by the program, participants also experienced clear expansion of mentoring relationships with working professionals; 69% of respondents reporting having a professional mentor (someone working in tech industry) at program completion, compared to only 15% at the start of the program. Participants reported developing mentoring relationships through a variety of mechanisms, including managers or other colleagues with whom they shared a common interest/background, staff, or assigned professional mentors. Whether developed through formal or informal mechanisms, many respondents reported that they now have valuable connections to professionals working in industry, on which they can rely for advice and guidance.

5.7 (PO) Clarified Career Goals

Programming was cited as providing exposure to new opportunities and prospects for participants' career paths. Company visits, networking events, and hearing from other participants about their experiences were viewed as impacting their experience and career direction. Exposure to diverse career opportunities in tech helped to clarify professional aspirations. The "networking, dinner, and company events" provided a "much broader understanding of the tech industry and how to progress my career in this industry." Some participants noted that these events provided them a "better understanding of what I want in my future and what kind of work culture I think fits me."

Events and networking opportunities also influenced participants' perceptions of women in tech ("hearing the stories from them directly, especially if they were female software engineers telling us, that was very credible to me"). Participants stated that it was beneficial to meet and interact with women working in various technology-related fields. Meeting these women provided a gained appreciation for the important role of women leaders in the industry. Qualitative data further showed how representation of women in tech positions impacted participants' beliefs about their own opportunities within their career. As one participant stated, "If you can't see [it], you can't be it." The opportunity to hear from women and learn more about their "career paths and everything they've done to get to where they are" was cited as providing "hope to have the chance to do the same thing."

6 Future Directions

Based on these evaluation research findings, there are some key considerations we will consider moving forward. The co-housing in a peer community played a key role in participants' experiences and development of core outcomes. Moving forward, the program will continue to emphasize the importance of participants' active engagement in their peer community, including more structured activities such as DTech Circles. To address challenges with peer group cohesion, the program may consider screening for potential participants' investment in developing a peer community during the application process. This would reduce the likelihood of participants who are interested in free housing more than developing meaningful relationships.

Respondents expressed explicit concerns about the ability of coaching staff to maintain the current level of support for participants as the program grows. Suggestions from participants included strategically offloading administrative duties to additional staff, so that leadership can focus on mentoring and guidance. In addition, program alumni may be utilized to provide coaching and guidance to younger peers, where appropriate.

The matched mentor provided by the program was underutilized by some participants. Respondents' suggestions for improving this programming component included enhancing the matching process to ensure that mentor/mentee backgrounds and interests are more aligned, as well as providing additional orientation to both parties in order to prepare them for their roles and how to best utilize their time. While participants valued the summer events planned by the program, the timing and frequency was at times burdensome for participants, and they struggled to balance their participation at these events with other responsibilities. Reducing the frequency of events and/or making some of them optional may help participants not to feel overwhelmed by the number of events they are expected to attend.

Although there is always room for program evolution based on lessons learned, it is clear from this research that students' self-efficacy within and outside of the class, their feelings of community, and their desire to persist computing have been impacted.

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