Developing Career Self-Efficacy of Researchers in Human-Centered Computing through Scholarship Support (Experience)

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Abstract

In 2014, an American land-grant research university in the South began a new cycle of the National Science Foundation (NSF) Scholarships in Science, Technology, Engineering, and Mathematics (S–STEM) grant entitled the Human-Centered Computing Scholars (HCCS): Fostering a New Generation of Underrepresented and Financially Disadvantaged Researchers. This project was a continuation of NSF Grant No. 1060545, which supported students at this university, originally funded in 2011. The HCCS program sought to advance doctoral students' career self–efficacy by financial support, offering opportunities for students to participate in career-based advising sessions, professional development, and other work-related experiences, informed by Gardner (2006) that suggests that doctoral students pass through three phases (entry, candidacy, and completion) as they matriculate through their programs. The model employed acknowledges that both supportive and challenging experiences are present at each phase and can positively or negatively influence doctoral student outcomes. Thus, the HCCS program includes critical learning opportunities within each phase of their studies which are presented in this work.

Background

For several years, the United States (U.S.) federal government and other national entities have expressed the significant need for an increase in the highly skilled STEM workforce. Non–profit organizations and companies have addressed this call to action by developing co–curricular and extra–curricular opportunities for students. Many targeted early learning stages, with the development of outreach activities, after–school programs, and summer camps, in an effort to increase the post-secondary pipeline with prospective low-income and underrepresented students. Some of these efforts have generated positive outcomes, including the implementation of CS curriculum. Several focused on creating spaces for underrepresented student populations, in an effort to increase the ethnic and socioeconomic diversity in these fields. And while some may inspire students to pursue these fields in higher education, limited support structures exist to support students in post–secondary education, especially for underrepresented student populations.

The State of Computing

Every year, the Computing Research Association (CRA) conducts the Taulbee Survey, receiving responses from Ph.D. granting academic units in the computer science, computer engineering and information departments in the U.S. and Canada. The results from the survey "document trends in student enrollment, degree production, employment of graduates and faculty salaries."[1] The data collected by the survey represents the two preceding academic years (2015-2016 and 2016-2017) and the periods of the reported measures differ between the two years.

According to the 2016 Taulbee Survey, the total undergraduate enrollment in computing majors among U.S. CS departments increased 12.6% and 12.7% between the academic years ending 2015-2016 and 2016-2017 respectively. In contrast, university faculty and staff are not increasing at a similar rate to provide personalized instruction for students[2]. As reported by the CRA, for the tenth consecutive year there was an increase in the number of new undergraduate computing majors, despite the capacity pressures facing departments. And while enrollment in CS overall has increased, studies indicate the lack of traditionally underrepresented students pursuing computing-related fields (Rosson 2011, Jackson 2011).

At the doctoral level, the total doctoral enrollment across Taulbee responding departments decreased by 1.4% from the 2015 academic year to the 2016 year. Data from respondents of the 2016-2017 survey indicate that the number of minorities enrolled in doctoral programs is still below 5%. Of the respondents to the 2016 Taulbee Survey, ethnic minorities accounted for only 11.2% of those awarded doctoral degrees in the 2016 academic year. Females comprised 18.5% of doctoral degree recipients, which dropped from the 2015 values, despite increased participation in the survey[1]. Thus, there remains a lack of diversity at the post-secondary educational level and within the workforce.

Prior research indicates ethnic isolation, individualism, lack of financial support, insufficient faculty interaction and other factors contribute to the lack of diversity in computing fields, particularly at the doctoral level[3]. Providing students with effective mentorship could assist in alleviating these circumstances and improve their willingness to continue in the computing sciences[4]. Additionally, developing ecosystems or networks that create, promote, and increase social capital of underrepresented students could factor into their ability to persist and transcend these and other unfavorable experiences. In 2016, Charleston et al. revealed that parental involvement, mentorship, counseling, and peer interaction can deeply impact self–efficacy and persistence in students pursuing degrees in the computing sciences. Their work also described the need for interventions designed to re-establish science, technology, engineering, and mathematics (STEM) student self–efficacy at each level of education (i.e. undergraduate, masters and doctoral degree levels)[5].

Additional Barriers to the Ph.D.

Prior research by Somers et al., Baker et al., and Ziskin et al. indicate that students with low socioeconomic status (SES) often perceive their academic learning environments as not being concerned with supporting students like them, with the inadequacy of work and scholarship opportunities being a common complaint.[6,7,8] Learning environments also have a profound influence on the learning, socialization, and well-being of the people who function in them (Zweben 2016). Work investigating the impact of need-based financial aid on college outcomes are scarce on the graduate level, and slightly less scarce on the undergraduate level. One paper by Castleman et al., found significant effects of need-based grant eligibility on STEM attainment for undergraduate college students and suggested that expanding need-based aid programs may be a sound investment, in tandem with efforts to address academic readiness and psycho-social barriers to STEM attainment.[9]

Over the last 10 years, the cost of college has far outpaced growth in incomes[10]. Furthermore, with federal aid for graduate students declining, (e.g., programs such as the Science and Mathematics Access to Retain Talent (SMART) Grant), the average level of unmet need for graduate students is rising. This trend disproportionately affects students from low-income households because they have fewer resources to rely on, which results in this population being more likely to borrow more, cut their course loads (extending time to graduation), or even dropout. Low-income students with significant amounts of unmet need, even when they are performing well academically and are making satisfactory progress towards completion, take longer to graduate.[11] This negative effect is especially pronounced and disproportionately affects students who belong to racial groups that are underrepresented in STEM. Brazziel and Brazziel surveyed students to identify barriers for those who obtained bachelor's degrees in STEM but did not persist on to doctoral study.[12] In the study, financial concerns were found to be one of four factors that were barriers for African Americans. In addition, Lewis and Collins reported that for underrepresented minorities, the accumulation of additional college debt deters many students from graduate academic endeavors, but it was later discovered that the students were unaware of the many graduate funding opportunities.[13]

In concert with financial instability and lack of representation, self-efficacy emerges as an additional barrier to doctoral degree attainment. Researchers in the social sciences, engineering education, and computer science education have offered insight into the lack of representation, pulling ideas central to social cognitive factors such as self–efficacy, goals, and outcomeexpectations[5]. Self–efficacy is defined as the "belief in one's capabilities to organize and execute the courses of action required to manage prospective situations[14]." There have been several studies conducted that investigate self–efficacy in science, technology, engineering and mathematics (STEM) students[3-15]. Each study highlights effective methods in improving STEM student performance in and persistence through the pipeline from post-secondary education into the workforce. Leveraging this empirical knowledge in light of the state of computing in the U.S. is of particular importance, as the economy shifts towards the need for professionals trained in technical fields.

The HCCS Program

The University of Florida began a new cycle of the National Science Foundation (NSF) Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) grant entitled the Human-Centered Computing Scholars (HCCS): Fostering a New Generation of Underrepresented and Financially Disadvantaged Researchers in 2014. This was a continuation of NSF Grant No. 1060545, which supported students at Clemson University. The NSF S-STEM program seeks to improve the education of gifted, low income STEM students and increase their employment and graduation rates[16]. The program also seeks to understand what factors attribute to the successful retention and graduation of the aforementioned demographic. Consistent with the broader program requirements on the national level, HCCS participants were involved in faculty-guided, innovative projects that allowed them to not only grow as researchers, but also support the growth of other undergraduate, master's and doctoral students. These interactions were intended to help prepare the participants to enter the computing workforce as a professor or research scientist.

The project was informed by research which suggests that doctoral students pass through three phases (entry, candidacy and completion) as they matriculate through their programs[17]. The model employed acknowledges that both supportive and challenging experiences are present at each phase and can positively or negatively influence doctoral student outcomes. Thus, the HCCS program includes critical learning opportunities within each phase of their studies.

For first year doctoral students, academic advising and research engagement experiences are designed to help HCCS participants understand how to achieve success in graduate school and understand the scholarly expectations. In year 2, participants are expected and encouraged to work on a research paper, work on a conference presentation, work on a research project, as well as achieve academically in their courses. In year 3, HCCS participants are mentored by senior faculty and have the opportunity to lead a research study. Students in year 3 of the HCCS program are also expected to work on research projects with other doctoral students as well as help undergraduate students to develop research skills, while successfully pursuing coursework and doctoral degree requirements. In year 4, HCCS participants are expected to lead research and writing projects, lead several conference presentation proposals, work with other graduate students, help undergraduate students to complete projects, excel academically, complete their dissertation research, and apply for employment opportunities in academic or research settings. In year 5, HCCS participants are expected to graduate from the university as well as procure a job as a research scientist or professor. At the end of year 5, a no–cost extension was allowed, in order to continue to support remaining HCCS participants until all program funds were exhausted. Some modifications based on the results of the program evaluation in year 5, additional programming was added to support the students.

Figure 1: HCCS Program Components

Research Design

Theoretical Framework

Based on Bandura's social cognitive theory (1986) which suggests that behaviors and attitudes are mediated and moderated through a complex dynamism of socially–based stimuli, Lent, Brown, and Hackett (1994), advanced the social cognitive career theory to formally consider the role of perceived and realized social interactions on an individual's career and academic development. The social cognitive career theory is diagrammed in Figure 3. The program components, Instructional modules, and HCCS research experiences, as shown in Table 1, that constitute the program, were developed by interpreting the hypothetical relationships as articulated in social cognitive career theory. Also, consistent with the theoretical framework, HCCS participants serve as research mentors for undergraduate students from the Computing Research Association Women's Distributed Research Experience for Undergraduates program.

The following propositions from Lent et al.'s (1994) social cognitive career theory (pp. 91–98) informed the development and implementation of HCCS Program:

- Proposition 1. An individual's occupational or academic interests at any point in time are reflective of his or her concurrent self–efficacy beliefs and outcome expectations.
- Proposition 2. An individual's occupational interests also are influenced by their occupationally relevant abilities, but this relation is mediated by one's self–efficacy beliefs.
- Proposition 3. Self–efficacy beliefs affect choice goals and actions both directly and indirectly
- Proposition 4. Outcome expectations affect choice goals and actions both directly and indirectly.
- Proposition 5. People will aspire to enter (i.e., develop choice goals for) occupations or academic fields that are consistent with their primary interest areas,
- Proposition 6. People will attempt to enter occupations or academic fields that are consonant with their choice goals, provided that they are committed to their goal, and their goal is stated in clear terms, near to the point of actual entry.
- Proposition 7. Interests affect entry behaviors (actions) indirectly through their influence on choice goals.

Career Self-Efficacy

Of particular interest was understanding the HCCS participants' career self–efficacy. Career self–efficacy refers to the confidence that individuals have in their ability to utilize information, Ideas, and skills to yield occupational outcomes (e.g., searching for jobs, applying for jobs, participating in job interviews, attaining job offers, negotiating job dimensions, and sustaining a consistent work history)[18].

Procedures

The purpose of the program evaluation was to examine the effects of the HCCS program on participants' educational experiences and occupational outcomes. Accordingly, the program evaluation project explores the following research questions:

1. What are the effects of the HCCS program on participants' academic experiences and outcomes?
2. What are the effects of the HCCS program on participants' career development experiences and outcomes?
3. What types of scholarly activities do doctoral students participate in as S-STEM participants?

The theoretical framework informed the analytical procedures of each of the major dimensions of the project evaluation. It should be noted that information derived from the theoretical framework was also used to interpret the research findings. Employing statistical analysis (Pedhazur, 1997) and qualitative research methods (Lincoln, 1985), the evaluation project was designed to examine HCCS program participants' intellectual dispositions and career orientations. Thus, in addition to examining the effects of the HCCS program using quantitative techniques, qualitative research elements were also integrated into the research design to assess students' experiences in their doctoral program. To examine the relationships among HCCS program participants' academic orientations and student engagement experiences, mixed methods research approaches were utilized[19]. As shown in Figure 2, the evaluation project was based on a cyclical analytical strategy.

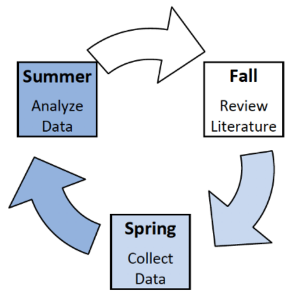

Figure 2: HCCS Data Evaluation Plan

A full program evaluation was conducted in 2016, year 5 of the grant, to determine the success of the HCCS Program. Quantitative data was collected across three instruments. The demographic questionnaire collected data about participants' demographic information and academic background. The Doctoral Student and Development and Outcomes Survey, created using the research of Nettles and Millet (2006) and Lovitts (2001), was used to assess the satisfaction and scholarly engagement of the students' academic experience[20,21]. The Career Decision Self-Efficacy Scale (CDSEC), which was originally derived from the Competence Test portion of the Career Maturity Inventory, included five sub-scales measuring self-appraisal (knowing yourself), occupational information (knowing about careers), goal selection (selecting a job), planning (looking ahead to the future) and problem solving (what should they do). Overall, this assessment measures the participants' confidence in pursuing and achieving career goals[22].

Participants

The ethnic, socio–economic, and gender diversity of the HCCS participants was quite different from the institutions they attended for their doctoral programs. Several of the HCCS participants were recruited from Historically Black Colleges and Universities (HBCUs) and other universities in cooperation with the Institute for African American Mentoring in Computing Sciences (iAAMCS). The ethnic and gender demographics of the participants are outlined in Figure 3. Of the participants, 70% were female. The largest group were Black females, comprising 50% of the overall participant group. The majority of the participants were first generation college students. Financial support was awarded to students who exhibited financial need and demonstrated academic merit based on their applications and recommendation.

The self–identified ethnic and gender demographics of

the participants included Black, Hispanic,and White, male and female students. 70% of all participants were female. The largest demographic group were Black females, comprising 50% of the overall participant group. The majority of the participants were also first-generation college students. During the award period, 4 scholars completed their Ph.D.s (20%) and 3 scholars left their academic program (1 went toindustry, 1 enrolled in another Ph.D. program, 1 dropped out).

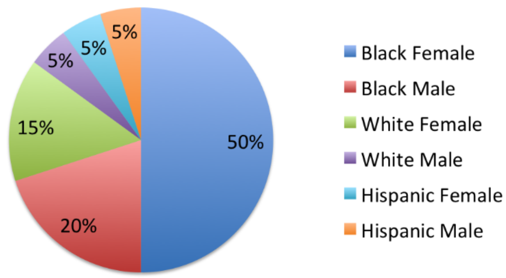

Figure 3: Demographics of the HCCS Program Participants

Data Collection

The data for the quantitative research component were collected annually using a survey instrument. An extensive number of items and scales were used to collect data for the S–STEM program evaluation. The survey was broken down into four sections: Doctoral Student Experiences, Doctoral Student Involvement, Doctoral Student Perceptions and Scholarly Activities. Data was collected from using the final instrument, the CDSEC. Data were collected online which enabled students to complete the survey instrument and submit their responses to a secure server. A brief description of each survey is shown below:

- Demographic Questionnaire. The Demographic Questionnaire consisted of 8 items. It was designed to ascertain information about participants' demographic characteristics and academic experiences.
- Doctoral Student Development and Outcomes Survey. This assessment category contained 54 items and was based on the work of Nettles, 2006 and Lovitts, 2001[20,21]. It contained several scales that measure the extent to which students were satisfied with their doctoral experience as well as engaged in productive scholarly activities in their doctoral program. The Doctoral Student Experiences section was based on a Likert–type scale and utilized an agreement or disagreement response scale (i.e., Strongly Disagree, Disagree, Neither Agree or Disagree, Agree, Strongly Agree).
- The Doctoral Student Involvement Scale. This section was based on a Likert–type scale and utilized a satisfaction–based response scale i.e., Very Dissatisfied, Dissatisfied, Neither Satisfied nor Dissatisfied, Satisfied, Very Satisfied. The Doctoral Student Perceptions section was based on a Likert–type scale and utilized frequency items (i.e., Never, Seldom, Sometimes, Often, Very Often).
- Career Decision Self–Efficacy Scale. The Career Decision Self–Efficacy Scale contained[25] items and employed a Likert–type scale. This scale, which included five sub–scales (i.e., Self–Appraisal, Occupational Information, Goal Selection, Planning, and Problem Solving), was designed to assess the extent to which respondents had confidence in their ability to pursue and achieve occupational goals (Betz and Klein, 1996; Betz, Klein, and Taylor, 1996).

Statistical Procedures

A quasi-experimental research design[23] was utilized to conduct the program evaluation annually for doctoral students who participated in the HCCS program and doctoral students who did not participate in the HCCS program (N = 18). Thus in 2016, doctoral students in the HCCS program (n = 10, treatment group) and students who did not participate in the HCCS program (n = 8, control group) completed a battery of assessments. Utilizing descriptive statistical analyses[24-25], the project team expected that there would be discernible differences in the perceptions and productivity of doctoral students based on their HCCS program participation status. Group comparisons were based on scores from the Doctoral Student Development and Outcomes Survey and the Career Decision Self–Efficacy Scale. The use of this quasi-experimental design enabled the project team to assess the extent to which participation in the HCCS program helped its participants to navigate their doctoral program, develop career orientations, and pursue employment outcomes. It should be noted that the control group students, while not participants in the HCCS program, may have been mentored by the project team.

Limitations

Due to the inherent under–representation of doctoral students pursuing computing degrees at a given institution, the control group contained persons from across the country. Thus, the experiences of these students are varied, despite all coming from similarly sized universities and computing programs. Other limitations include the impact of transitioning institutions during the HCCS program on the data, particularly the retention of students.

Activities

The scholars conducted research in Human–Centered Computing and worked on projects related to accessibility, biometrics, virtual humans, virtual reality, educational technologies, information technology policy and social computing. Many participated in structured and un–structured programs designed to mentor undergraduate student researchers. Each HCCS participant was also given an opportunity to participate in a summer internship with a government or industrial research lab.

HCCS participants presented their research findings at prestigious conferences such as the ACM Special Interest Group on Human-Computer Interaction (SIGCHI), ACM/IEEE International conference on Human-Robot Interaction (HRI), E–Learn, American Society for Engineering Education (ASEE), International Conference on Human–Computer Interaction (HCII), and Human Factors and Ergonomics Society (HFES). Scholars also received financial support to attend scholarly conferences to present their research and participated in several activities associated with the Institute for African–American Mentoring in Computing Sciences (IAAMCS) (NSF Grant No. 1457855). Students were also provided with the opportunity to participate in internships with a government or industrial research labs.

Several students published their research during and after their tenure in the HCCS Program. To further expand the grant's reach, scholars organized and led CodeIt Day for 3 consecutive years. CodeIt Day is an outreach event where middle school students have the opportunity to learn about Computer Science in a fun and hands-on environment. Scholars also served as facilitators for several UF Computer Science Outreach programs such as Hour of Code where they impacted over 1,000 high school students (70% underrepresented minorities) as part of a National Computer Science Education Awareness week.

Results

Data indicated that 56% of the program evaluation sample consisted of HCCS students. Descriptive statistical results highlight the impact of the HCCS program on doctoral students. The data indicated that HCCS participants reported greater satisfaction with the doctoral experience than students from other universities (i.e., control group). The qualitative data collected from the HCCS participants converged on the idea that the programmatic elements of the HCCS program positively influence HCCS students' development. More specifically, it was shown that providing research experiences, providing leadership opportunities, and encouraging mentoring relationships among HCCS participants promotes the development of a scholarly community.

Doctoral Student Experiences

The data in this section suggest that HCCS participants were more likely to note that faculty members were instrumental in their intellectual development. Additionally, HCCS participants were also more likely to report that they made the right decision to pursue the doctoral degree and the right decision in choosing their doctoral program. When compared to the control group, HCCS participants noted it was easy to develop personal relationships with faculty members in the program, that there is a great deal of contact between professors and students outside the classroom, that they were satisfied with the level and types of student organizations and committees in the program, and that there was a strong sense of community and a shared interest and purpose.

Doctoral Student Involvement

Data indicated that HCCS participants were more satisfied with the quality of faculty instruction, fairness of the program in providing financial support, collegial atmosphere between students and faculty, quality of academic advising, quality of feedback on scholarly projects, quality of professional advising and job placement, class scheduling, and faculty interest in student research. These data support the notion that the HCCS program enables students to navigate their academic environment while integrating educationally–appropriate strategies. The data also suggests that the HCCS program enables doctoral students to formulate research projects with the assistance of faculty. Additionally, HCCS students worked with other students to develop research projects and engage in scholarly collaborations to explore several topics in human–centered computing. By enabling HCCS participants to initiate research projects at all phases throughout their doctoral program, students are able to apply information learned in class to research projects that represent cutting–edge scholarly areas. Moreover, the HCCS program encourages students to participate in activities that promote team–building and scholarly engagement among students and faculty.

Doctoral Student Perceptions

Data collected from this survey suggested that doctoral students in the HCCS program were more likely to report participating in an informal study group with other graduate students, discussing academic issues outside the classroom with faculty members, receiving feedback about academic progress from faculty, socializing informally with a faculty member, discussing career plans and ambitions with a faculty member, and discussing personal problems or concerns with a faculty member. Also, HCCS participants, compared to the control group, reported greater satisfaction with the social environment. HCCS program participants also reported greater satisfaction with their academic experiences and research training experiences. The data from this section indicated that HCCS participants had the opportunity to engage in developmental experiences that have been shown to support retention and graduation outcomes[20]. For example, HCCS program participants receive career development information which helps students to obtain a comprehensive understanding of their career options in academia and corporate settings. HCCS program participants generate research ideas about innovative topics in the field of computing. Additionally, HCCS students discuss research strategies and research methodologies to solve complex problems.

Scholarly Activities

In terms of the number of scholarly products that students pursued during the academic year, HCCS participants reported a greater number of manuscripts submitted for publication, manuscripts in progress, conference presentation proposals in progress, conference presentation proposals submitted, conference presentations completed, grant proposals in progress, patent projects submitted, internships applied for, internship interviews completed, ongoing research projects, and research projects in which they mentored undergraduate research team members. For each of these aforementioned items, the control group participants reported a lower number of scholarly deliverables. HCCS program participants work in a research laboratory setting with other students to develop and test technologies that are designed to enhance society. HCCS program participants also participate in research conferences and are thereby afforded the opportunity to write conference presentation proposals as well as lead and facilitate scholarly presentations. The HCCS program participants also interact with faculty and students while engaging in career development experiences. Additionally, HCCS students participate in mentoring experiences with undergraduate students as well as graduate students. Mentoring experiences enable HCCS participants to develop social skills such as communication skills and the ability to teach in informal settings which has implications for the development of advising skills and leadership skills. As a result of participating in laboratory meetings, HCCS students are encouraged to practice and refine their writing skills and presentation skills.

Discussion

The HCCS program supported twenty underrepresented doctoral students in computing. While this number is seemingly small, the lack of diversity in computing as presented in the annual Taulbee Survey, the National Science Board's Science and Engineering Indicators, and ASEE data articulate the necessity for this work. Data from the Taulbee Survey 2016-2017 indicate that the number of minoritized students enrolled in doctoral programs is still below 5%t. Ethnic minorities accounted for only 11.2% of those awarded doctoral degrees in the 2016 academic year, while females comprised 18.5% (dropping from the 2015 values, despite increased participation in the survey). In order to evaluate the success of the HCCS program, the evaluation team conducted a longitudinal mixed methods survey of the participants. Of particular focus was the participants' career self–efficacy. The confidence that individuals have in their ability to utilize information, ideas, and skills to yield occupational outcomes (e.g., searching for jobs, applying for jobs, participating in job interviews, attaining job offers, negotiating job dimensions, and sustaining a consistent work history) is referred to as career self–efficacy. Preliminary data indicated the program could benefit from additional experiential components to further develop students' belief in their ability to prepare for and obtain jobs in the computing sciences. To that end, in the final (no–cost extension) year of the grant, the program was expanded to include additional professional development opportunities through participation at both technical and affinity conferences and professional events and the results of this additional intervention are presented. The scales utilized a five–point Likert scale, where higher scores expressed higher levels of self–efficacy. The self–efficacy measured by the scales relates to the individual's confidence in utilizing information and skills to produce career–related outcomes. Of the five sub–scales, the HCCS participants only documented higher scores on the scale measuring occupational information. The overall higher scores of the control group as measured by the instrument indicated that there was room for improvement in the areas of self–appraisal, goal selection, planning and problem solving for HCCS participants.

The empirical data collected by the evaluation team highlighted strategies that the project team could implement to improve the quality of the HCCS program. For example, while many HCCS participants discussed significant opportunities for interactions with faculty, additional experiences could be needed to help students explore their individual research interests and manage their time efficiently. Moreover, the data implies that additional workshops should be implemented that relate to applying for internships, preparing career–related documents, negotiating internship and job offers, and understanding how to conduct collaborative projects with researchers and students. Additionally, a series of specialized experiences for the HCCS participants consisting of seminars that address a host of academic, research and career development issues was also a suggested improvement. Many of these suggested improvements specifically pointed towards the need for more robust programming that addresses career self–efficacy. As a result, additional experiences were cultivated by the program and attended by the scholars.

In lieu of the results from the program evaluation, additional conferences were supported including the American Society for Engineering Education Zone II Conference, a venue where students were able to submit several articles for publication. Additionally, students were supported to attend the National Association of Multicultural Engineering Program Advocates Conference, where scholars received opportunities to participate in future faculty programs and invited talks. Expanding the number of conferences supported was implemented to broaden student experiences and strengthen their professional networks.

Sample Program Improvement: Black Women in Computing (BWIC)

In 2017, the Research Coalition for Black Women and Girls in Computing held its inaugural BWIC event in Washington DC. The focus of the event was to encourage dialogue around the advancement of BWIC. This was done through the celebration of the intersectionality of race and gender in computing by creating new networks within the community, developing leadership, communication, wellness and career development skills and more. With the largest demographic of HCCS being Black women, the scholars were encouraged to participate. Several other Black female graduate students in computing were also supported to attend the event with HCCS travel scholarships. BWIC provided an opportunity for meaningful connections with potential mentors in government agencies, academia, and industry.

HCCS students and those supported by HCCS funds remained in contact after the event and in April of 2017, a BWIC summit was held at the University of Florida after these participants expressed interest in maintaining relationships and building community. Black female faculty from other institutions along with masters and undergraduate students at the host university were also invited to participate this new HCCS program. Invited faculty came from a variety of positions within the academy in the areas of Computer Science, Computer Engineering, Engineering Education and Journalism. The focus of this event was to improve the social capital and self–efficacy of the student participants. The agenda included the sharing of best practices and encouragement to persist through student and faculty panels, broader discussions, and flash talks. This summit addressed each of the five sub–scales of the CDSEC. Using feedback from the first event, an updated version of this event is under development where data will be collected for future publication.

Conclusion

At the highest level of degree attainment, the HCCS program is contributing to the self–efficacy of its participants. Several of the HCCS participants are now approaching the end of their graduate programs and some have recently graduated. Many of those who have continued to be involved in the HCCS program are interested in pursuing academic careers and have expressed interest in providing similar support to their future students. Two of the scholars have already accepted tenure track positions, and others are on the job market. Future research on these participants may provide longitudinal data that could provide insight into how programs like HCCS contribute to improving the pipeline for future generations of underrepresented faculty in Computing. Additional evaluation of the newly integrated programs to support the participants, such as the BWIC events, is required to determine its impact on the scholars' career self–efficacy. Additionally, programs will be further developed to ensure that students feel as if their needs are being met in the other four areas measured by the CSDEC. Ideally, the introduction of mentors and the fellowship of students from similar backgrounds through BWIC events and conference attendance will assist in the scholars' in areas of goal selection, planning and problem solving. The improvement in these areas could potentially enhance the scholars' appraisal and confidence in themselves.

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