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The Gap Between the Need and the Realities in Mentoring Computer Science Students by Faculty*

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***Abstract*— This paper describes the gap between the need for mentoring computer science students and available faculty resources. The critical role that mentorship plays in workforce development and in the educational progress and career success of students is highlighted.**

Keywords*— *mentoring, underrepresented students, computer science faculty, diversity

I. Introduction

A robust workforce of computer scientists is critical to ensuring national security and competitiveness. Yet, there are many more jobs in the computer science industry than there are computer science professionals available to fill those jobs. With the national need for computer science, computer engineering, and robotics professionals soaring, computer science departments are struggling to attract and graduate students from low-income and other minoritized groups (Stephenson et al., 2018). The projected growth rate from 2021 to 2031 in the numbers of U.S. computer science jobs available is 15%, which is three times faster than the growth rate for all occupations combined (OOH, 2022); and, although there is a temporary downsizing in technology employment currently, there are still over 700,000 unfilled computer science jobs available, with only 80,000 computer science new college graduates available to fill them (Computer Science: Opportunity for Every Student, 2022; Kencare, 2022). Moreover, women and students from low-income and ethnic minority groups are vastly underrepresented in computer science and engineering and are not entering these fields at the rate of young people from dominant and majority groups in the U.S (Kallia & Cutts, 2021 Lunn, et al. 2021). Thus, they are not available to provide the variety of perspectives needed for effective problem-solving in computer science domains, nor are they available to use their knowledge of computer science to help solve the healthcare, environmental, infrastructure, and economic challenges that plague their own neighborhoods and communities (Turner et al., 2022). Therefore, it is critical for universities to not only educate students but to mentor them in STEM fields in order to both meet workforce demands and to help them prepare for careers that are commensurate with their talents, interests, and goals.

II. The Power of Mentoring

Research has shown that mentoring is a powerful mechanism in the support of students who are pursuing and attaining computer science and engineering degrees (e.g., Cyr et al., 2021). Mentoring, which emphasizes the relationship between the mentor and mentee with the purpose of helping the individual grow and accomplish personally-valued educational and professional goals (National Academy of Sciences, 2019), provides students with a sense of belonging, opportunities to develop a strong professional identity, and opportunities to network with other professionals and professionals in training (Apriceno et al., 2020; Burke & Sunal, 2010; Burleson et al., 2021; Giles, 2017; Zorec, 2020). Mentors can help underrepresented students hone their skills and professional knowledge, in order to increase their opportunities to propel successfully into computer science fields (e.g., Cyr et al., 2021). Mentors, who can provide expert guidance and share wisdom gained through experience, can assist students in making decisions that are right for them (Foster, 2022). Mentors encourage students, and give them a sense of hope, helping them to persist to graduation and thus enabling them to pursue career success (Jackson & Winfield, 2014). Mentors anchor students and help them feel that they are part of a meaningful social structure, which in turn can help them meet their goals, rather than feeling as if they are lost in a large university with little hope that they can find their way (Hollands, 2012). Mentors can increase universities' efforts to attract, retain, and graduate students from diverse backgrounds who have not historically had a strong presence in computer science and engineering fields (NASEM, 2019). In particular, mentoring has become even more important in helping students align their expectations, needs, and skill development with employers' expectations and demands (NACE, 2022)."

III. The Challenge of Mentoring

Nevertheless, both mentors and mentees find that engaging in mentoring relationships can be complex and challenging. Mentoring has been historically viewed as a one-way relationship, with the mentor choosing the topics addressed in the mentoring relationship and the direction of the mentee's educational and career paths, while the mentee accepts and profits from that directive relationship (NASEM, 2019). However, scholars who study mentoring today have observed that students, and particularly STEM students, aspire to be much more self-directed (Caravello et al., 2015). Today's students have greater expectations of

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individual freedom and choice than students had in the past, and they perceive mentors as coming alongside them and supporting their interests and goals, rather than unilaterally directing their educational and career choices (Caravello et al., 2015). This leaves mentors in that sometimes-uncomfortable position of trying to provide mentees with opportunities for individual expression while helping them to set goals that are worthwhile and attainable and that will propel them into the career paths that they will find satisfying, and consistent with their individual talents and dreams.

The challenges faced when mentoring today's students using mentoring models that were effective even 20 years ago are compounded by the educational crucible that students coming out of the pandemic are facing. a) Today's students have expressed beliefs that their learning opportunities were compromised, and therefore, they are not as confident in their skills as they would like to be (Sharaievska, 2022). b) Both faculty and employers have found that students do not necessarily display the social, communication, and teamwork skills that students at their developmental level displayed pre-pandemic (NACE, 2022). c) Moreover, faculty mentors are mentoring students who are facing tough individual challenges related to both their recent experiences with the pandemic as well as their reactions to personal difficulties (Turner et al., in preparation). The reactions of students to the trauma and isolation they experienced during the pandemic to date are still being revealed as faculty, student advisors, college mental health personnel, and researchers are endeavoring to detect students' current needs, which have been found to be at least somewhat different than students had in the past (Turner et al., in preparation). d) Finally, the underrepresentation of women and minorities in STEM means that students may not be able to be matched to mentors who are from the same demographic groups and populations as they are. The pool of available faculty mentors is mostly White (64%) and mostly male (78%) in U.S. universities while students are more and more from multicultural populations (although still mostly male [77%]) (See Table 1) leaving faculty with the additional challenge of mentoring students who may not share the same life experiences, values, knowledge, perspectives, or ways of communicating.

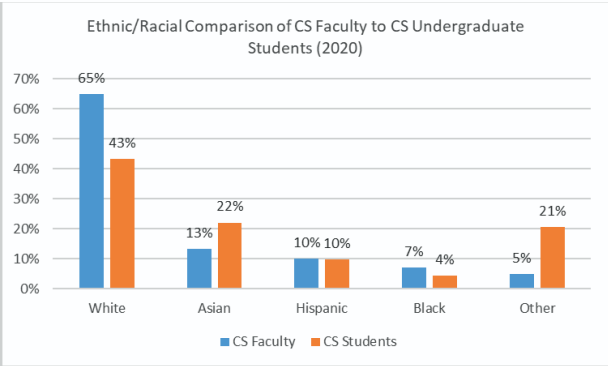

Figure 1

IV. Addressing the Gap

To meet the training and professional development needs of today's computer science students, faculty mentors must be prepared to help them build confidence in their skills and abilities. Faculty mentors must serve as a guide and role model for them as they strive to navigate a fast-moving and ever more demanding profession and serve as a bridge from being a student to becoming a new professional. To do this, faculty mentors must also be able to communicate and work with students from diverse backgrounds with whom they may need to take extra care to build trusting relationships (Womack et al., 2020). Finally, faculty mentors need to be able to listen to students, recognize when they are in crisis, and refer them for appropriate mental health or other assistance when needed.

However, computer science faculty who have had little experience or training in mentoring, in particular in mentoring students from other cultures, ethnic groups or genders, maybe at a loss for how they could effectively mentor and support their students in ways that could increase their students' opportunities for success. The question becomes, then, what type of faculty mentoring models are most effective at this time for this group of students, and what types of training do faculty need to effectively mentor computer science students. This gap between students' mentoring needs and faculty's mentoring resources must be addressed by theorists, researchers, university administrators, and policymakers. The consequences of not doing so can hamper universities from fulfilling our potential to train students from diverse backgrounds and to prepare computer science students to contribute to computer science-based solutions for the problems of today and tomorrow.

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