Experiences Of Faculty Mentoring Engineering Transfer Students

Deniz Nikkhah

BME Grad student at UCI

David A. Copp (Assistant Professor of Teaching)

David A. Copp received the B.S. degree in mechanical engineering from the University of Arizona and the M.S. and Ph.D. degrees in mechanical engineering from the University of California, Santa Barbara. He is currently an Assistant Professor of Teaching at the University of California, Irvine in the Department of Mechanical and Aerospace Engineering. Prior to joining UCI, he was a Senior Member of the Technical Staff at Sandia National Laboratories and an adjunct faculty member in Electrical and Computer Engineering at the University of New Mexico. His broad research interests include engineering education, as well as control and optimization of nonlinear and hybrid systems with applications to power and energy systems, multi-agent systems, robotics, and biomedicine. He is a recipient of UCSB's Center for Control, Dynamical Systems, and Computation Best PhD Thesis award and a UCI Chancellor's Award for Excellence in Undergraduate Research Mentorship.

Kameryn Denaro

Dr. Kameryn Denaro is a Research Specialist at the Division of Teaching Excellence and Innovation at University of California Irvine. Her research interests are in STEM education, equity and inclusion, and student success.

Natascha Buswell

Natascha Trellinger Buswell is an assistant professor of teaching in the department of mechanical and aerospace engineering at the University of California, Irvine. She earned her B.S. in aerospace engineering at Syracuse University and her Ph.D. in engineering education in the School of Engineering Education at Purdue University. She is particularly interested in inclusive teaching conceptions and methods and graduate level engineering education.

Gregory Diggs (Assistant Director)

Hye Rin Lee

Lorenzo Valdevit

Anna-Lena Dicke

Experiences Of Faculty Mentoring Engineering Transfer Students

Introduction

Increasing achievement of underrepresented students in science, technology, engineering, and mathematics (STEM) is a critical and difficult task [1]. Underrepresented students make up a small fraction of the STEM workforce (13%) compared to white students (71%) [1]. Mentorship, particularly research mentorship, plays an important role in the development of scientific identity [2] and improves students' moral, performance, and retention rates [3]. Therefore, mentoring underrepresented students in research is critical for increasing their achievement. Students who receive research mentoring have described mentors as colleagues who provided them an opportunity to flourish. These students were more likely to identify as scientists, whereas those who did not have research mentors had varying degrees of scientific identity [2]. The benefits of maintaining a positive mentor relationship can extend beyond the mentee's academic career. In fact, mentees who had a positive relationship with their mentor reported greater job satisfaction and a decreased likelihood of stagnation in their career [4]. The combination of a stronger identity and an increase in overall performance of a student during and after their academic career highlights the importance of continuing research in mentor-mentee interactions. However, previous research largely focuses on the benefits that students gain from mentor-mentee relationships. To better understand the intricacies of the mentor-mentee relationship, in this work we investigate the benefits that faculty mentors gain and what it takes to become a successful mentor.

We investigated benefits that faculty members perceived from mentor-mentee relationships in a National Science Foundation (NSF) Scholarships in Science, Technology, Engineering and Mathematics (S-STEM) funded program at the University of California, Irvine. The program aims to support low-income, transfer students who are pursuing baccalaureate of science degrees in engineering. As part of the program, faculty mentor these students through degree completion. To study this mentoring, we performed one-on-one interviews with S-STEM faculty mentors and asked questions that were divided into four subcategories: (1) how the mentors' identity and past experiences shaped their mentor-mentee interactions; (2) how diversity and equity factors influenced their mentor-mentee interactions; (3) what strategies they used to become successful mentors; and (4) what personal and professional outcomes the S-STEM mentors obtained from their mentoring interactions. Through qualitative coding and thematic analysis of these interview responses, we identified important characteristics and approaches mentors used to build effective mentor-mentee relationships, and benefits and skills that faculty mentors developed through these interactions. Our findings show that, while the motivation for becoming a mentor varied, all mentors strived to ensure that their students would feel like they belonged in their program. Our findings align with the smaller body of previous research on mentors' experiences and show that mentors value the opportunity to give back and to stay connected in the profession, to relive former academic career memories, and to encourage the next generation of engineers [3].

Research Questions and Methods

RQ1. What motivates S-STEM faculty mentors to become mentors?

RQ2. What are effective strategies that S-STEM mentors can use to help students persist in academia and foster a sense of belonging?
RQ3. What do S-STEM faculty mentors perceive as the benefits of S-STEM mentor-mentee interactions?

To answer the research questions listed above, five S-STEM faculty mentors were interviewed via Zoom. The interviews were recorded and fully structured using the questions in Table 1. Audio files were transcribed into text files, and thematic analysis [4] was performed to find meaningful interpretations, as well as patterns and trends in the interview responses. Similarities and differences in pattern themes were then analyzed, compared and combined by one researcher using constant-comparative analysis to identify main themes/factors that shaped meaningful mentor-mentee interactions, as shown in Table 2.

Table 1: Interview questions

Identity
1.   Why did you decide to be a mentor for undergraduate students?
2.   What factors encourage you to continue your relationship as a mentor with the S-STEM mentees?
3.   How do your past personal/ professional experiences influence your interaction with your mentees? (Socioeconomic status/race/ethnicity)?
4.   How do your previous mentors influence your interaction with your mentees?
Strategies for success
1.   Why do you think you are a successful mentor?
2.   What approaches do you think you use in your mentoring relationship that helps your mentees the most in research and career development?
3.   What type of communication approaches do you use to be responsive in mentoring?
4.   What type of approaches do you use to be proactive in mentoring?
Diversity and equity
1.   How does mentoring students from different racial backgrounds influence your mentor-mentee interactions?
2.   How is mentoring S-STEM students which are coming from low-income backgrounds /transfer students different from your other faculty-student mentorship experiences?
3.   What are your strategies for fostering a sense of belonging for your mentees?
Personal and professional benefits
1.   What benefits do you think you obtained from mentoring S-STEM students?
2.   What mutual beneficial outcomes do you think this mentorship relationship has had both for you and your mentees?

Table 2: Codebook

Categories	Themes
● Identity ● Strategies for success ● Diversity and equity ● Personal and professional benefits	● Selflessness ● Active engagement and acceptance ● Understanding and accommodating ● Satisfaction and mutually beneficial

Results and Discussion

Related to RQ1, similar themes were found within all the interview question subcategories. For questions relating to identity, we found that all participants perceived mentoring as rewarding

because they get to see students develop through their undergraduate experience, but the motivating factors that caused faculty to pursue mentorship varied. Some mentioned positive experiences with their own mentors as a motivating factor, while others cited their lack of mentorship during their undergraduate and graduate experience. Furthermore, mentors who experienced personal hardships (e.g., with socioeconomic status or being an underrepresented person) felt that their experiences would help them guide students who were in similar situations. These findings are consistent with a separate study in which mentors cited the opportunity to remain engaged in the field as well as to mentor future faculty as a major motivating factor in becoming a mentor [5].

Related to RQ2, when asked about what makes them successful mentors, mentors highlighted the importance of openly and actively communicating with students to ensure that they are receiving the guidance they need. Furthermore, faculty mentors emphasized the importance of meeting a student's specific needs. Mentors cited consistent communication between mentor and mentee as an effective approach to be proactive in mentoring, for creating healthy and meaningful relationships, and for providing a foundation to ensure that mentees find success. With consistent communication, mentors can guide students academically and also develop personal relationships with the students to be able to provide more general life advice.

Mentors emphasized the importance of addressing unique challenges that a specific group may face when asked about their experience working with low income and transfer students. This may include accommodating busy schedules of students who work several jobs or listening to the impact that events outside of school (e.g., protests, discrimination, etc.) have on a student. Addressing these specific needs of the S-STEM students with varying socioeconomic status or racial backgrounds is critical so they are not at a disadvantage compared to other students. Studies have shown that a lack of cultural literacy can lead to a less meaningful mentor-mentee relationship [7]. Most S-STEM faculty mentors believe finding faculty members that can relate to diverse students (regarding economic status, race, etc.) is very important and allows students to feel comfortable, more relatable to their mentors, and open to getting help from their mentors. We learned S-STEM mentors perceive that transfer students lack peer-cohort experience that non-transfer students can build starting in their freshman year. Therefore, they believe a meaningful mentor-mentee interaction in the S-STEM program should emphasize presenting transfer students with resources that allow them to quickly form relationships and build experience in their academic programs. When asked how to create a sense of belonging among their students, mentors highlighted the importance of having an open attitude towards all backgrounds. Some mentors mentioned the impact imposter syndrome has on some students and emphasized the importance of actively reassuring students that they do in fact belong. In order to create an environment in which the students felt like they belonged, one mentor would reassure their students through positive verbal affirmations. Other mentors would hold regular meetings in which students would discuss with their peers the research they were conducting and any challenges they were facing. This was done to create a sense of camaraderie amongst the students that would ultimately foster a feeling of belonging.

Finally, related to RQ3, when mentors were asked what professional and personal benefits they obtain from mentoring S-STEM students, all mentors responded that they felt a sense of personal

satisfaction when their students would succeed in academia and beyond. One mentor mentioned that working with a diverse group of students helped the mentor develop their own communication skills, while another mentor mentioned the ability to write and publish papers with the help of undergraduates as mutually beneficial to both the mentor and mentee. Some mentors experienced their students becoming industry/professional contacts once they graduated and described the experience overall as positive. This aligns with previous findings that faculty mentors feel satisfaction not only in their own achievements but also an even greater feeling of satisfaction when looking at the success of their mentees who went on to take leadership roles in their careers [8]. The benefits that a mentor gains is subjective to them and is based on the goals that they had entered the program with. However, an overarching theme amongst the responses from the mentors was the satisfaction of seeing their mentees succeed.

Future Work

We plan to survey and interview S-STEM students about their mentor-mentee experiences and the benefits they gained from these interactions. We believe by analyzing results from students' interviews and comparing them to mentors' interviews we can better understand key factors that help to develop successful mentor-mentee interactions and thereby inform the design of future programs and mentor-mentee interactions.

References

[1] Lane, T. B. (2016). Beyond academic and social integration: Understanding the impact of a STEM enrichment program on the retention and degree attainment of underrepresented students. *CBE—Life Sciences Education*, *15*(3). https://doi.org/10.1187/cbe.16-01-007

[2] Atkins, K., Dougan, B. M., Dromgold-Sermen, M. S., Potter, H., Sathy, V., & Panter, A. T. (2020). "looking at myself in the future": How mentoring shapes scientific identity for STEM students from underrepresented groups. *International Journal of STEM Education*, *7*(1). https://doi.org/10.1186/s40594-020-00242-3

[3] Wilson, J. A., & Elman, N. S. (1990). Organizational benefits of mentoring. *Academy of Management Perspectives*, *4*(4), 88–94. https://doi.org/10.5465/ame.1990.4277215

[4] Walensky, R. P., Kim, Y., Chang, Y., Porneala, B. C., Bristol, M. N., Armstrong, K., & Campbell, E. G. (2018). The impact of active mentorship: Results from a survey of faculty in the Department of Medicine at Massachusetts general hospital. *BMC Medical Education*, *18*(1). https://doi.org/10.1186/s12909-018-1191-5

[5] Mendez, S. L., Tygret, J. A., Conley, V. M., Keith, R., Haynes, C., & Gerhardt, R. (2019). Emeriti faculty as mentors: The Benefits and rewards of mentoring the next generation. *Mentoring & Tutoring: Partnership in Learning*, *27*(4), 439–457. https://doi.org/10.1080/13611267.2019.1649921

[6] Belotto, M. (2018). Data Analysis Methods for qualitative research: Managing the challenges of coding, interrater reliability, and thematic analysis. *The Qualitative Report*. https://doi.org/10.46743/2160-3715/2018.3492

[7] *Mentoring across cultures*. Mentoring Across Cultures | Tomorrow's Professor Postings. (n.d.). Retrieved February 4, 2022, from https://tomprof.stanford.edu/posting/839

[8] Manthiram, K., & Edwards, K. M. (2021, July 26). *Reflections on the mentor-mentee relationship*. OUP Academic. Retrieved March 17, 2022, from https://academic.oup.com/jpids/article/10/11/1040/6328551?login=false