

Kickstarting an Engineering Success Center at a Hispanic Serving Institute

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Keywords: education center, HSI, career development, academic services

Abstract

San Francisco State University is a Hispanic Serving and a Primarily Undergraduate Institution located in the diverse San Francisco Bay Area community. As part of a National Science Foundation Hispanic Serving Institute Improving Undergraduate STEM Education grant, the Engineering Success Center was established in late 2021, with an official launch in Spring 2022. SFSU's School of Engineering is home to 1,400 undergraduate students of which 67% are ethnic minorities, and 18% are female. Surveys conducted through Institutional programs showed that only 14% of students attained a position prior to graduation. Within this context, the Engineering Success Center was created to build capacity in the School of Engineering by increasing academic and career development services. Through expanding these critical services, the Center aims to address challenges of retention, graduation rates, and transition into the workforce. The establishment of the Engineering Success Center was met with the additional challenge of developing its services during the COVID-19 pandemic. At SFSU, through Spring 2022, there was still a significant percentage of courses being taught via remote modality. Students were geographically spread out, yet eager to create a sense of belonging within the School of Engineering. The Center initiated several services in the first semester including: tutoring, academic excellence workshops, and strategies for success seminars. This paper will share the experience of the Center's first year. Communication was a huge component of the Engineering Success Center's effort due to the wide distribution of students across learning modalities and physical locations. Analysis of effective means of student engagement and the impact of attendance on presentations/seminars due to remote offerings will be discussed. Tutoring was offered as a hybrid option to broaden the range of students participating and engaging with the service. This paper emphasizes the lessons learned and the external evaluation conducted at the end of the Center's first semester.

1. Introduction

In 2021, San Francisco State University was awarded a National Science Foundation (NSF) Hispanic Serving Institute (HSI) Improving Undergraduate STEM Education (IUSE) grant. This grant was a collaborative and multi-disciplinary effort within the School of Engineering (SoE). The SoE is home to 1,400 undergraduate students with 67% identifying as underrepresented minorities (URMs) and 18% female [1]. Prior to the COVID-19 pandemic, engineering enrollment was steadily increasing, with a recent drop in the Fall of 2019. Various Institutional surveys raised attention to concerning statistics regarding the retention, graduation rate, and entry into the engineering industry for students, particularly those from underrepresented minority

groups. On average, between 2017 and 2020, the retention rate of freshmen Hispanic students in their fourth year is 41% significantly lower than Hispanic transfer students' 79% retention rate. Beyond the graduation and retention rates, there is concern regarding students' entry into the workforce. Surveys revealed that only 14% of students reported employment secured at the time of graduation. Considering that most SOE students decide to pursue a career in industry post-baccalaureate, this statistic needs to be better understood and addressed to increase student success and diversification of the workforce.

The Strengthening Student Motivation and Resilience through (S-SMART) research project was initiated in late 2021 under the NSF HSI IUSE grant to respond to the existing trends and opportunities for improvement at the school of engineering. The project has three central pillars: a Summer Research Internship program, Inclusive Faculty Workshop, and Engineering Success Center (ESC).

While the Summer Research Internship program and the Inclusive Faculty Workshop are discussed in other publications in the ASEE PSW and ASEE annual conferences [2] – [5], this paper focuses on the ESC. The mission of the ESC is to increase student resilience by providing access to academic and career development resources. This mission outlined a series of activities to address the students' needs. One major challenge in establishing the ESC was the COVID-19 pandemic. Following local health organization recommendations, SFSU took a more progressive approach in transitioning to complete in-person activities. When the ESC launched in Spring 2022, the start of the semester was conducted online for the first three weeks. After this point, mainly lower-division undergraduate courses were brought back to campus for in-person learning. The majority of upper-division and graduate-level courses remained online, which introduced a challenging situation as the SoE population was not only split in terms of learning modality but also geographically. Approximately one-third of engineering students originate from Southern California, with the remainder distributed throughout the expanding San Francisco Bay Area. As a result, there was a distribution of students who were local and geographically too far to participate in any in-person activities offered.

Considering the constraints and continued health concerns, the ESC launched a series of activities that combined in-person and online services that leveraged available technology. An external evaluator surveyed engineering students at the end of Spring 2022 to assess their experiences with the ESC.

2. Method

The ESC offered activities and services in the areas of academic and professional development. The following will provide an overview of these services.

2.1 Academic Resources

Advising - In SFSU's Student Success and Graduation Initiative [6], advising and inadequate evaluation of transfer credits were cited as the top reasons for not meeting expected graduation dates. Additionally, faculty advising by major showed the lowest level of satisfaction. Students in the SoE are typically required to meet with a faculty member from their major every semester ahead of the next semester's registration period. However, the COVID-19 pandemic interrupted this process. From the Spring of 2020 until the Fall of 2022, advising was no longer mandatory. Considering the importance of advising in the student experience [7]-[9], the ESC Advising sessions were initiated to tackle the need for continuous venues for academic and career assistance at the one-on-one level. The advising sessions were conducted with the Center's Director via Zoom video conferencing software. To overcome the silence and uncertainty of Zoom waiting rooms, advising appointments were made available through a University booking system on the ESC website. Student advising covered topics ranging from course management, reviewing course progress towards graduation, resume/cover letter review, and interview preparation.

Tutoring - On the SFSU campus, tutoring is available through a centralized tutoring center. However, the predominant emphasis is on lower-division courses, especially in math, science, and humanities. As a result, there was a void in the offerings for students pursuing the technical core classes in their engineering curriculum. These courses tend to leverage their foundational knowledge and challenge their skill sets. Tutoring is shown to be a powerful contributor to academic success [10] [11]. As a result, four tutors were hired in Civil, Computer, Electrical, and Mechanical Engineering. The hourly paid tutors provided four hours of tutoring services per week. This schedule led to ESC offering tutoring Mondays thru Thursdays from the third week of classes to the last day of class. Due to the diverse modalities of students, tutoring was offered both in-person and online using Zoom. Tutoring appointments and drop-in sessions were available to allow for students who wished to secure time slots ahead of time and those who needed immediate help.

Academic Excellence Workshops - As there are various student organizations in the department, it was important for the ESC to create events and activities that filled in gaps in the current resources. In Spring 2022, the ESC offered three online academic excellence workshops on mental health, Fundamentals of Engineering (FE)/Engineer-in-Training (EIT), and engineering graduate school requirements and application process. These activities were done in collaboration with student professional organizations, including the Society of Women Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, and the Society of Hispanic Professional Engineers. Collaborations were necessary as the department's attendance to online events was low throughout the pandemic and this helped ensure maximum outreach to the student community. Some of the offered activities were meant

to destigmatize discussions on subjects such as mental health, which was significantly impacted by the solitude of remote learning. Overall, the events targeted subject matters pertinent to student success.

2.2 Career Development

The development of students into young professionals is a process that takes time and dedication. It expands beyond mastering the technical theory and must involve the development of soft skills to assist the students in being competitive in the workforce. Through department surveys, approximately 70% of students indicated they would pursue engineering employment post-baccalaureate. However, only 14% could secure a position before graduation, with 54% of this group acquiring a full-time position. Only 48% of students stated that their University experiences had prepared them for the job market. With the pandemic, the opportunities for personal enrichment were greatly limited, with the loss of internship programs, networking events, and overall social interactions with colleagues in a technical atmosphere. Revitalizing these efforts and advancing their development is crucial for student professional development, which has shown to be a significant contributor to successful entry into the workforce [12]-[15]. We tried to overcome these limitations and leverage the advantages of online interactions through the following events.

Strategy for Success Seminars - These events were focused on expanding students' perspectives of resources and skills associated with the engineering fields. The ESC engaged in three events: an Engineering Resources Fair, Students Orgs 101, and Technical Writing Seminar. These seminars presented the importance of connecting with University organizations within and outside the department to the students. They also emphasized writing and communication skills. These elements are essential to student success as they teach them how to be resourceful and emphasize the significance of communication, which is often misunderstood as a non-technical skill.

Career Development and Industry Networking Info Sessions - Industry connections are critical to students' progress toward their academic and career goals. These interactions open up the perspective of career aspects and provide real-life connections to classroom material. By offering these activities online, the industry professionals had more flexibility to participate as it removed barriers related to the commute and increased traffic in the San Francisco Bay Area as businesses started to reopen. Events were conducted with two private and one public agency during this time. Students were engaged in presentations, highlighting current projects and programs offered for internship and full-time positions by the participating companies. In parallel, the department continued to offer online Career Fairs. To prepare and support students' career aspects before and after these events, the ESC offered sessions on LinkedIn profiles and Elevator Pitches, bringing in alumni with expertise in these topics.

Peer Mentorship – Another service offered through the ESC was peer mentorship. In discussions with other student organizations, this had been previously attempted with varying interest levels from the student community. Considering the pandemic’s impact on social interactions and creating students’ learning differences, peer mentorship was identified as an excellent opportunity to engage students with upperclassmen, alum, and industry professionals on a one-to-one basis. An introductory mentee event was organized to bring interested students together and teach them about the mentor-mentee relationship, including best practices. Students completed a short survey to understand their mentorship goals better.

2.3 Communication

Due to the remote and in-person modalities of the student community, communication was a crucial component of the ESC’s outreach. The team leveraged several means of communication to maximize their outreach to students including Discord, department emails, and a page on the official department website.

Discord is a website that allows participants to create their own public or private channels where they can instant message their followers. These messages can be categorized into sub-categories such as scholarships or job openings. This platform is currently well-used for courses at SFSU as well as other local universities and community colleges. This served as an excellent way to give students reminders of events on the day-of as well as answer questions for everyone.

The department sends weekly emails to the undergraduate students advertising the events in the department along with any submitted news items from faculty, instructors, or staff. The ESC submitted weekly newsletters in the form of a JPG image that would be included in these emails. This gave students a quick glimpse at the events coming up as well as reminder of current services.

Lastly, the ESC developed a website. This has been a great resource with pages developed to include an archive of video recorded Zoom events. This was one benefit of online events that they could be easily recorded, edited, and archived for future reference. Videos for various events including our Fundamentals of Engineering exam info session are posted there.

Overall, even with the challenges of the COVID-19 pandemic, the ESC presented a variety of activities in the first semester of active work. An external evaluation was performed to gauge student interest and reception of these new resources in the department.

3. Results

In April 2022, the project’s independent external evaluator Dr. Robert Petrusis from EPRE Consulting, led the project evaluation. Dr. Petrusis worked with the project team to develop a quantitative survey instrument to distribute to the entire SoE student community. The questions were developed to provide context to the students’ perspective of their position within the department as well as their impressions of the ESC’s services. Through advertising via department emails and promoting an incentive raffle, 218 students were surveyed. The following highlights the responses received.

Initial questions inquired about students’ demographic information (i.e. major, year, graduation date), student organization participation, and familiarity with the ESC. The students’ majors and years are summarized in Figure 1. Of this group, 60% of these students started their academic careers at SFSU, and 41% were already active in one or more student organizations in the department.

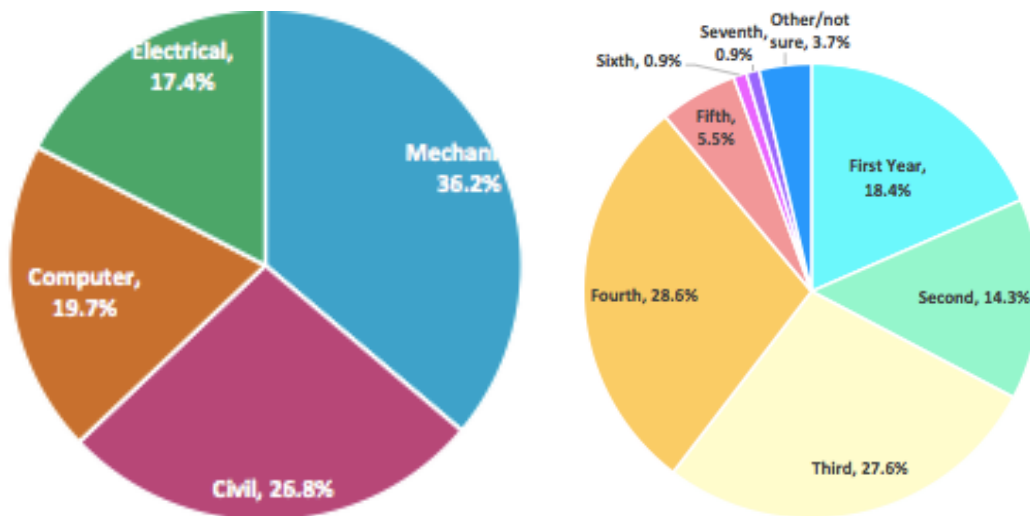


Figure 1. Survey Participant Demographics - Major (left) and Year of Study (right)

The remainder of the survey responses presented in Figures 2 through 7 used a 6-position Likert scale with response options of “Strongly Disagree” (1), “Disagree” (2), “Slightly Disagree (3), “Slightly Agree” (4), “Agree” (5), and “Strongly Agree” (6). “Does not apply” was also an option, and these responses were not included in the analysis. The following questions were answered by students who participated in ESC activities or services. Of those surveyed, approximately 60% were aware of the ESC prior to the survey, with 49% of students learning about the available services through the weekly department emails and their classes.

3.1 Academic Resources

There was a strong positive response to the Academic Resources provided in the first semester of the ESC as shown in Figures 2 through 4. Based on the highest average mean values, the most effective service was Academic Excellence Workshops; this outcome reinforced the need for workshops to expand upon the traditionally discussed subject matters and push the boundaries by encouraging students to discuss issues such as mental health and options for graduate school. At SFSU, undergraduates predominantly enter the industry post-baccalaureate versus graduate school, which could be correlated to the economic uncertainty associated with the pandemic. Additionally, the inclusion of the FE/EIT workshop could correlate to lower student engagement in the classroom which would expose students more to this exam and the licensure procedure. These results emphasized the need for more workshops that provide a forum for lengthier discussions on topics not thoroughly covered in the course curriculum. With respect to tutoring, we identified a need to reinforce the course curriculum by incorporating software skills to support other areas of student success.

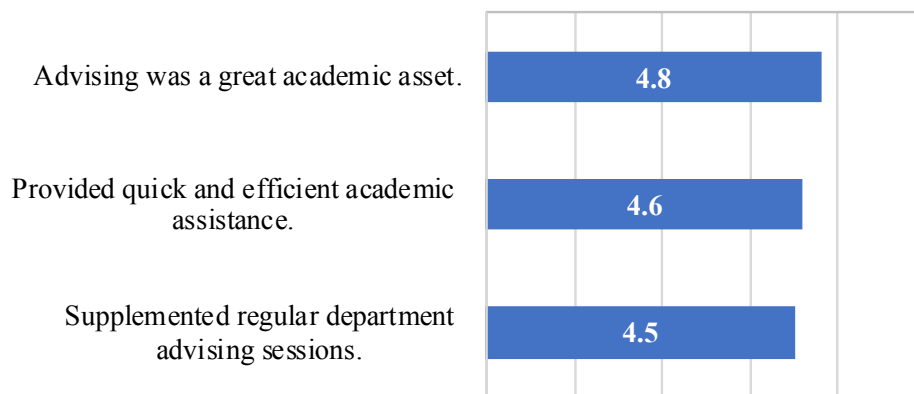


Figure 2. Advising Service Assessment (Arranged by Mean)

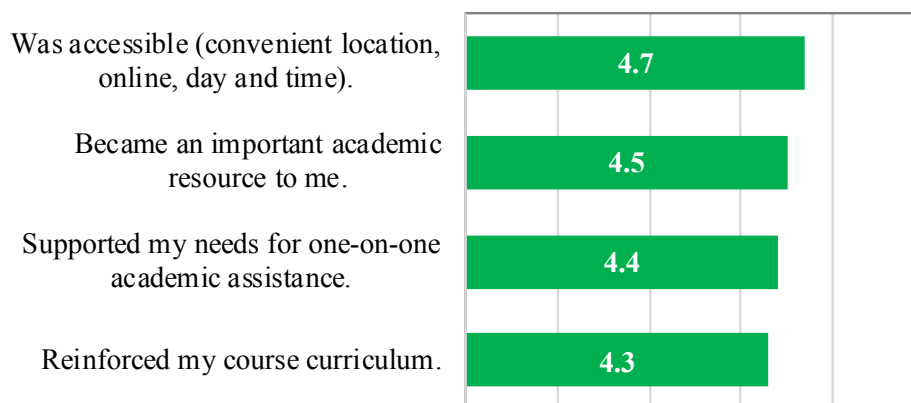


Figure 3. Tutoring Service Assessment (Arranged by Mean)

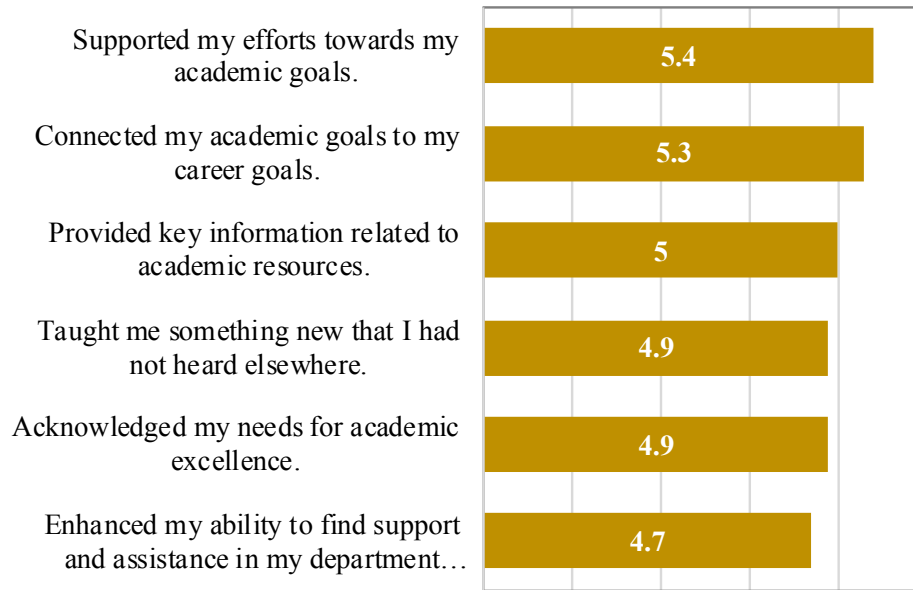


Figure 4. Academic Excellence Workshop Assessment (Arranged by Mean)

3.2 Career Development

Students responded well with higher mean values across the three major career development services as shown in Figure 5 through 7. One of the most beneficial activities was the Info Sessions. These sessions achieved the goals of motivating students' course progress while supporting their development of engineering identity. It was encouraging that these sessions assisted in acquiring a position, considering entry into the workforce was a critical motivation in developing the ESC.

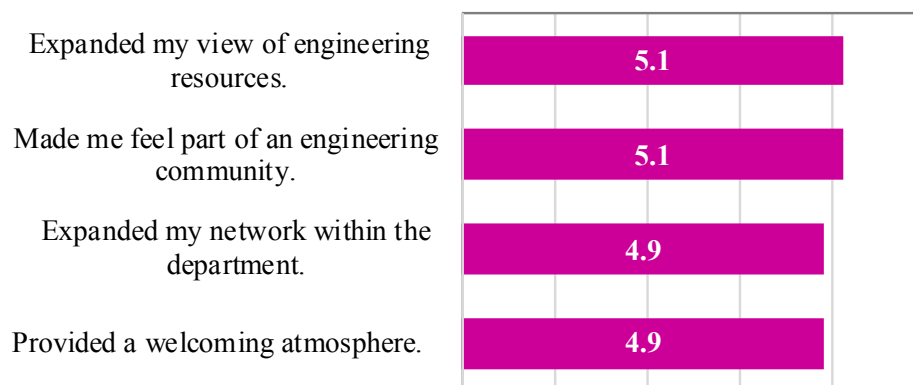


Figure 5. Strategy for Success Assessment (Arranged by Mean)

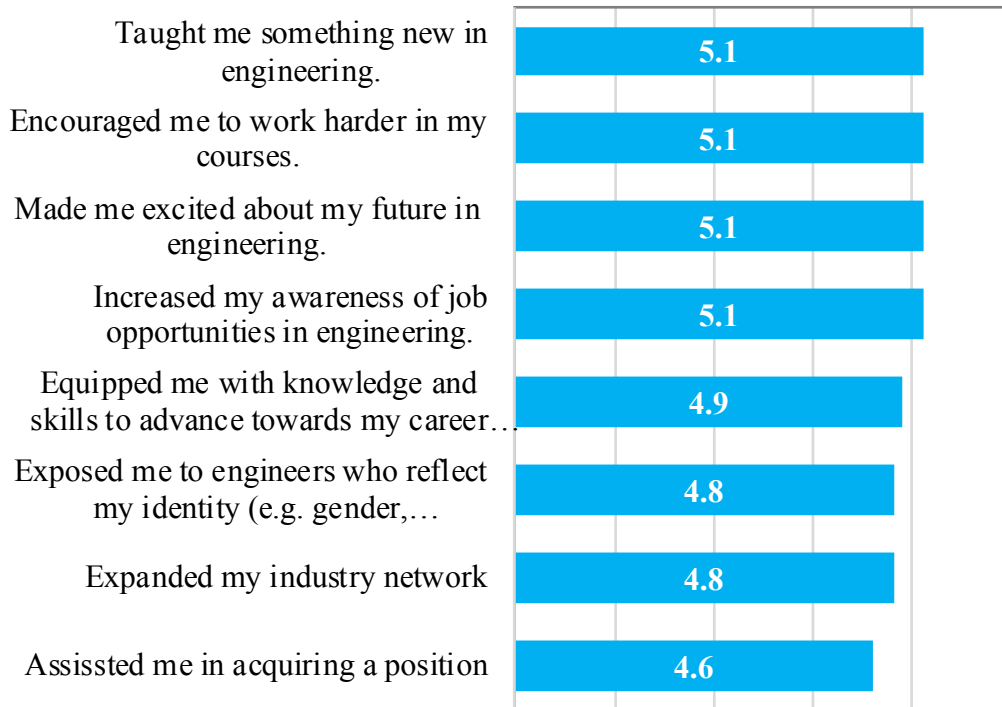


Figure 6. Info Session Assessment (Arranged by Mean)

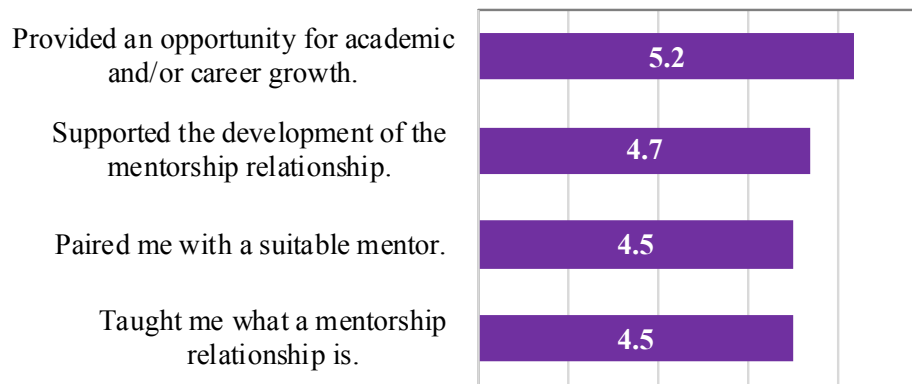


Figure 7. Mentorship Assessment (Arranged by Mean)

4. Conclusion

SFSU's SoE is a growing department with needs in academic and career development resources that were only heightened by the COVID-19 pandemic. Establishing a new engineering center under a pandemic's unique and rare conditions challenged our traditional view of student support. However, through the use of technology, the ESC was able to launch its efforts using in-person and online modalities to reach as many students as possible.

The breadth of services targeted key objectives of the overall NSF HSI IUSE project, including retention and entry to the workforce. It will take several years of evaluation to fully grasp the impact of the ESC's efforts and understand which activities and services were the most influential.

Considering the difficulties of modality, the external evaluation results are promising and highlight the services that students view as most beneficial. These activities include info sessions and academic excellence workshops. A key common feature among these two activities is that they open discussions and connections with previously untapped topics and resources. These outcomes emphasize the need to continue expanding our efforts beyond traditional companies and course discussions to better support students' growth and perspective of their careers after graduation.

5. Acknowledgement

This material is based upon work supported by the NSF under Grant No. 2122176. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of NSF. The authors highly appreciate the support from NSF on the program.

6. References

[1] Institutional Research. "Student Data," 2020. Available at <https://ir.sfsu.edu/content/students-data>.

[2] F. Khalkhal, Z. Jiang, X Zhang, J Wong, and W. Pong (2023), "Analyzing student peer mentor experiences in a collaborative summer internship project between San Francisco State University and local community colleges in San Francisco Bay Area", *Proceedings of 2023 American Society for Engineering Education (ASEE) PSW Conference*, April 13-15, Los Angeles, CA.

[3] F. Khalkhal, J. Wong, X. Zhang, Z. Jiang, Y. Wang, and W. Pong (2023), "Fostering student success through faculty development workshops", *Proceedings of 2023 American Society for Engineering Education (ASEE) PSW Conference*, April 13-15, Los Angeles, CA.

[4] X. Zhang, D. Quintero, Z. Jiang, F. Khalkhal, Z. Qin, J. Wong, Y. Wang, W. Pong, and R. Petrusis (2023). "Development and First-Year Outcomes of a NSF-Funded Summer Research Internship Program to Engage Community College Students in Engineering Research", *Proceedings of 2023 American Society for Engineering Education (ASEE) Annual Conference & Exposition*, June 25-28, Baltimore, MD.

[5] Z. Jiang, X. Zhang, F. Khalkhal, J. Wong, D. Quintero, Y. Wang, W. Pong, and R. Petrusis (2023). "Strengthening Student Motivation and Resilience through Research and

Advising”, *Proceedings of 2023 American Society for Engineering Education (ASEE) Annual Conference & Exposition*, June 25-28, Baltimore, MD.

[6] C. Herrmann, E. Allen, & J., Kamariotis. ‘Transfer Voices: Fall 2019 Transfer Student Survey, San Francisco State University’ (2019): Available at: https://ir.sfsu.edu/sites/default/files/SFSU_TSS_Presentation_2020.pdf

[7] J. Levin and J. Wyckoff, “Identification of Student Characteristics that Predict Persistence and Success in an Engineering College at the End of the Sophomore Year: Informing the Practice of Academic Advising,” Division of Undergraduate Studies Report No. 1990.1, Pennsylvania State University.

[8] G. Zhang, T.J. Anderson, M.W. Ohland, and B.R. Thorndyke, “Identifying Factors Influencing Engineering Student Graduation: A Longitudinal and Cross-Institutional Study,” *Journal of Engineering Education*, vol. 93, no. 4, pp. 313-320, 2013.

[9] E.R. Winterer, J.E. Froyd, M. Borrego, “Factors influencing the academic success of Latinx students matriculating at 2-year and transferring to 4-year US institutions—implications for STEM majors: a systematic review of the literature,” *IJ STEM Ed*, vol 7, no. 34, 2020.

[10] H. Mustafa, H, “Work in Progress: Modeling a Tutoring Center to Improve Retention and Promote Student Success in Lower-level Engineering Classes Paper,” in *2018 ASEE Annual Conference & Exposition, Salt Lake City, Utah*, June, 2018.

[11] E.E. Offordile, E.C. Umeano, F.M. Adene, M.C. Obi, C.S. Ugwuanyi, C.I. Okeke, and D.E. Adimora, “Improving the academic achievement of low achieving secondary school students in physics using peer tutoring learning strategy: Implications for Engineering Career,” *International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)*, vol. 11, no. 3, pp. 201-212, 2021.

[12] P. Pantzos, L. Gumaelius, J. Buckley, and A. Pears, “On the role of industry contact on the motivation and professional development of engineering students,” in *2019 IEEE Frontiers in Education Conference (FIE), October 2019*, pp. 1-8.

[13] B. Johnson and J.B. Main, “The influence of experiential learning on student professional development: a literature review,” in *2020 ASEE Virtual Annual Conference, June 2020*.

[14] M. Ling, “EXPLORING EMPLOYABILITY DEVELOPMENT IN ENGINEERING UNDERGRADUATES”, 2021.

[15] S. Howell, W. Hall, and D. Geelan, “Exploring the perspectives of engineering undergraduates on employability and employability building activities,” *Higher Education, Skills and Work-Based Learning*, 2022.