Board 378: Responsive Support Structures for Marginalized Students in Engineering: Insights from Years 1–3

Dr. Walter C. Lee, Virginia Tech

Dr. Walter Lee is an Associate Professor in the Department of Engineering Education at Virginia Tech and the Director for Research in the Center for the Enhancement of Engineering Diversity (or CEED). He is broadly interested in inclusion, diversity, and educational equity—particularly as it relates to students from groups that are historically underrepresented or marginalized in engineering. Lee received his Ph.D. in engineering education from Virginia Tech; his M.S. in industrial & systems engineering from Virginia Tech; and his B.S. in industrial engineering from Clemson University.

Ms. Malini Josiam, Virginia Tech

Malini Josiam is a Ph.D. student in Engineering Education and a M.S. student in Civil Engineering at Virginia Tech. She has a B.S. in Mechanical Engineering from UT Austin (2021). Her research interests include improving equity in engineering and sustainability.

Taylor Y. Johnson, Virginia Tech

Taylor Y. Johnson is a graduate student at Virginia Polytechnic Institute and State University pursuing a Ph.D. in Engineering Education, where she serves as a graduate research assistant. Taylor earned her Bachelor's from The University of Texas at Austin in Biomedical Engineering. She was previously a member of the student support staff for the Virginia Tech Center for the Enhancement of Engineering Diversity where she served as an instructor for the first-year professional development seminar and as co-ordinator for the summer bridge program. Her research interests include equity in engineering education, middle-years of engineering, and engineering student support.

Mrs. Janice Leshay Hall, Florida International University

Janice is a postdoctoral researcher at Virginia Tech. Her research centers on diversity equity and inclusion with a focus on broadening the participation of historically underrepresented groups in the engineering workforce. Specifically, she examines the

Artre Reginald Turner, Virginia Tech

Responsive Support Structures for Marginalized Students in Engineering: Insights from Years 1-3

Introduction

The purpose of this NSF CAREER project is to advance understanding of the navigational strategies used by undergraduate engineering students from marginalized groups. Our goal is to identify insights that can be used to develop responsive support structures, prevent further harm, and address actors who perpetuate unjust systems. Our project will benefit the engineering education ecosystem by illuminating ways to transform engineering education to include more learning environments that value and uplift all of its participants. Our poster will present an overview of our: 1) conceptual model informing our data collection; 2) workshop development and implementation; and 3) instrument revision and piloting.

Project Overview

This project is a multi-case study with three phases in the research plan and two phases in the education plan. The project is guided by a conceptual model developed during Years 1 and 2 of the project. Phase 1 of the research plan is a single case study, which involves data collection at the PI's home institution, which is the current stage of the project. Part 1 of the education plan related to developing and implementing Situational Judgment Inventories is currently underway as well.

Before we began collecting data, we reflected on the research quality, ethics, and equity considerations outlined in the project proposal and updated our methods and theories to strengthen these considerations. We documented the process and justification for updating our project theories and methods from the original proposal in a ASEE 2022 conference paper [1].

Current Status

<u>Conceptual Model</u>

During the first year of the project, we developed propositions and a conceptual model to illustrate how localized, structural features unjustly shape the demands and opportunities encountered by students and influence how they respond. Our model highlights mechanisms and dynamics at work in influencing the experience, learning, or persistence of students in undergraduate engineering programs. This lens should prove useful for examining elements of the embedded contexts and support infrastructure of the learning environment.

Rather than directly beginning with data collection upon starting the project, we revisited the frameworks of Person-Environment Fit (PE Fit) and Critical Race Theory set forth in the proposal. We also considered other frameworks that could be used to conceptualize what it means for a student to "navigate" a learning environment. These frameworks include PE Fit [2],[3, Stress-Coping [4-6], Health Care Access [7],[8], and Service Quality [9] and consider

student navigation through four different perspectives: students as workers, people, patients, and consumers, respectively. Combined, these frameworks' constructs informed the development of our conceptual model and its guiding propositions.

We developed 11 propositions grouped into five categories, which informed our development of a conceptual model of student navigation of the engineering learning environment. The propositions work together to contextualize student navigation. For example, one of the propositions is *Student decisions are mediated by characteristics they have upon entering the learning environment, such as (a) their demographic identities and the visibility of those identities; (b) their familial and social networks; (c) their psychological characteristics; (d) their student status classification (e.g., transfer student); (e) their past experiences; and (f) their goals and desires.* This proposition aligns with a specific element of the model related to personhood.

The model is organized into six categories which are the learning environment, personhood, embedded contexts, sensemaking, responding, and support. These categories and their components directly correspond to the 11 propositions. We presented this conceptual model in a Journal of Engineering Education (JEE) article that is currently under review.

Education Plan

The goal of the education plan is to equip stakeholders with data driven tools to adequately support marginalized students in engineering. We plan to accomplish this plan through development, implementation, and evaluation of a Situational Judgment Inventory (SJI) [10].

We initiated the development stage of our education plan by developing and hosting a workshop with incoming first-year engineering students participating in a Summer Bridge Program (SBP) [11]. During the workshop, we presented students with scenarios (i.e. *Your first round of tests did not go well and your usual studying habits are not working*) to respond to through individual written response, small group written response and discussion, and a facilitated large group discussion. The scenarios spanned six domains: academic performance, faculty and staff interactions, extracurricular involvement, peer-group interactions, professional development, and special circumstances. We prompted the students to write down how they thought they would respond to the four scenarios they were given. For example, one student's individual written response to the scenario "*Your first round of tests did not go well and your usual studying habits are not working"* was "I would go to study hours to try and figure out what I'm doing wrong."

We also asked SBP students and upper division students during interviews to respond to several scenarios. The goal of collecting these scenario responses from students during the summer workshop and ongoing interviews is to inform the development of the SJI. We will use the written and verbal responses from students to determine specific response option choices in the SJI that are realistic and reflective of current student behavior.

Piloting Interview Protocols

To strengthen the utility of the conceptual model and gather additional information to inform our education plan, we refined and piloted our interview protocols with different groups of students. First we piloted one version of the interview protocol with incoming engineering students who were participating in the SBP. Examples of questions we asked during the interviews include: *What abilities do you think it takes to succeed in engineering and why?; How well prepared do you feel for engineering and why?; How would you respond to "you need additional assistance in a class and the instructor is being non responsive"?; How do you think the experience at this university is different for marginalized students?*

From our pilot with incoming students, we found that students anticipated similarities and differences between their SBP and their first semester of college. Additionally, we found that while students recognized that marginalization exists in engineering, they simultaneously expected "equal opportunity" in the engineering environment. Finally, we found that when asked how they would respond to challenging situations, students relied on what they had learned in the SBP to respond. Based on these results, we do not plan to interview more incoming engineering students.

We also piloted our protocol with upper division engineering students. Examples of questions we asked during the interviews include: *What university resources and/or employees (department/college/university) do you think contributes most to the success of engineering students?; Based on your experience, or based on the experiences of close friends, what do you see as the 3-5 most challenging aspects of being an engineering student at this university?; How would you respond to "you need additional assistance in a class and the instructor is being non responsive"?; How do you think the experience in engineering at this university is different for marginalized students?*

Our analysis of this pilot data is ongoing. Results will be shared at the time of the poster session. We will use the results to further refine our interview protocols and begin data collection at our first research site with upper division engineering students.

Next Steps

To complete Phase 1 of the project, we will begin data collection at Site 1 from upper division engineering students and university employees. We will also pilot our protocol with university employees and refine the employee interview protocol. Furthermore, we will develop a data analysis codebook for upper division engineering students and university employees. Current codebook development will be based on the pilot data with upper division students and is ongoing. We are also working towards SJI Development through ongoing analysis of the

workshop responses and student interviews, and we will develop an updated workshop for the SBP this upcoming July.

Acknowledgements
Thank you to the Center for the Enhancement of Engineering Diversity (CEED) at Virginia Tech for providing us the opportunity to host a workshop for incoming students during their summer bridge program. This material is based upon work supported by the National Science Foundation under Grant No. 1943811. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

References
[1] Josiam, M., Lee, W., Johnson, T., Pee, C., & Hall, J. (2022, August). Beyond Selecting a Methodology: Discussing Research Quality, Ethical, and Equity Considerations in Qualitative Engineering Education Research. In *2022 ASEE Annual Conference & Exposition.*
[2] D. M. Cable and J. R. Edwards, "Complementary and supplementary fit: A theoretical and empirical integration.," *Journal of Applied Psychology*, vol. 89, no. 5, pp. 822–834, 2004.
[3] P. M. Muchinsky and C. J. Monahan, "What is person-environment congruence? supplementary versus complementary models of fit," *Journal of Vocational Behavior*, vol. 31, no. 3, pp. 268–277, 1987.
[4] S. Folkman, R. S. Lazarus, C. Dunkel-Schetter, A. DeLongis, and R. J. Gruen, "Dynamics of a stressful encounter: Cognitive appraisal, coping, and encounter outcomes.," *Journal of Personality and Social Psychology*, vol. 50, no. 5, pp. 992–1003, 1986.
[5] R. S. Newman, "How self-regulated learners cope with academic difficulty: The role of adaptive help seeking," *Theory Into Practice*, vol. 41, no. 2, pp. 132–138, 2002.
[6] L. Slavin, K. Rainer, M. McCreary, and K. Gowda, "Toward a multicultural model of the stress process," *Journal of Counseling & Development*, vol. 70, no. 1, pp. 156–163, 1991.
[7] L. A. Aday and R. M. Andersen, "A framework for the study of access to medical care.," *Health Services Research,* vol. 9, no. 3, p.208, 1974
[8] L. A. Aday and R. M. Andersen, "Equity of access to medical care: A conceptual and empirical overview," *Medical Care*, 4–27, 1981
[9] A. Parasuraman, V. A. Zeithaml, and L. L. Berry, "A conceptual model of service quality and its implications for future research," *Journal of Marketing*, vol. 49, no. 4, p. 41, 1985.
[10] J. A. Weekley and R. E. Ployhart, "Situational judgment tests: Theory, measurement, and application," *The Organizational Frontiers Series*, 2013.
[11] Johnson, T., Josiam, M., Lee, W. (2023, April). "The only difference is now it counts:" Exploring the Role of a Summer Bridge Program in Shaping Student Expectations of Engineering. In *2023 CoNECD-The Collaborative Network for Engineering and Computing Diversity.*