

Facilitating Pathways to Engineering: First Year Summer Experience

Dr. Elizabeth Kurban, Women in Engineering, University of Maryland College Park

Elizabeth Kurban serves as the Assistant Director of Retention for the Women in Engineering Program at the University of Maryland Clark School of Engineering. Elizabeth's professional and research interests broadly surround STEM-field access and persistence for women and underrepresented minoritized student populations. She is passionate about equity, diversity, and inclusion in higher education, particularly in the context of engineering. Elizabeth earned her Ph.D. in Higher Education at the University of Maryland's College of Education. Prior to her journey at UMD, Elizabeth worked in higher education policy research in Washington, DC and earned an M.S.Ed in Higher Education Administration from the University of Pennsylvania and an M.A. in Cognitive Science from the University of Delaware.

Dr. Mary L Bowden, University of Maryland College Park

Acting Director of the Women In Engineering Program Senior Lecturer and Keystone Instructor Clark School of Engineering

**Conference Paper for 12th Annual
First Year Engineering Experience (FYEE) Conference**

**Facilitating Pathways to Engineering:
First Year Summer Experience**

Proposal Abstract

The [SCHOOL OF ENGINEERING] is a limited enrollment program at the [UNIVERSITY]. Unfortunately, not all students who are interested in studying engineering are directly admitted into the [SCHOOL OF ENGINEERING], but instead are admitted into [UNIVERSITY]'s Division of Letters and Sciences (L&S). There are many students of minoritized identities (such as women and racial/ethnic minoritized students) who are not directly admitted into the [SCHOOL OF ENGINEERING], but instead are admitted to the L&S division. Students not directly admitted will later have the opportunity to re-apply to the [SCHOOL OF ENGINEERING] after strengthening their application and preparation. As such, there is a critical opportunity to promote the pathways for women and students with other minoritized identities into the field of engineering through facilitating the process for L&S students in re-applying to the [SCHOOL OF ENGINEERING].

The 2019 First Year Summer Experience (FYSE) program was designed to strengthen and facilitate pathways into the field of engineering through assisting and supporting the [UNIVERSITY]'s L&S students who are interested in studying engineering, but were not directly admitted into the Clark School. FYSE is a three-week summer orientation program focused on the development and strengthening of math-intensive engineering problem-solving skills. Equally important is the cultivation of community and a network of support among each FYSE cohort. Recruitment and selection of participants to FYSE is geared toward the inclusion of women, racial/ethnic minorities, and first-generation college students who were not directly admitted into the Clark School. The 2019 program served a diverse cohort of approximately 21 first-year women students who applied to study engineering but were admitted to the Division of Letters and Sciences.

This paper will provide a detailed overview of the components and implementation of the FYSE 2019 Program. It will also include demographic information on the participants, program evaluation outcomes from participants, and any relevant updates on longitudinal tracking the 2019 FYSE cohort.

Facilitating Pathways to Engineering: First Year Summer Experience

*“The greatest strength of the FYSE Program is its faith in us as future engineers...”
- 2019 participant*

Introduction

Previous retention research suggests that summer bridge programs can be especially beneficial in enhancing college readiness and student success for underrepresented student populations (Ackermann, 1990; Gleason et al., 2010; Kallison & Stader, 2012). The First Year Summer Experience (FYSE) program seeks to support first-year women and racial and ethnic minoritized students in their transition to the [SCHOOL OF ENGINEERING] through a three-week summer orientation program focused on both strengthening academic preparation and building community and a network of support.

The [SCHOOL OF ENGINEERING] is a limited enrollment program at the [UNIVERSITY]. Unfortunately, not all students who are interested in studying engineering are directly admitted into the [SCHOOL OF ENGINEERING], but instead are admitted into [UNIVERSITY]’s Division of Letters and Sciences (L&S). One of the main reasons for not being directly admitted into the [SCHOOL OF ENGINEERING] is due to students’ lower performance in mathematics, as evidenced by high school mathematics courses and mathematics test scores¹. There are many students of minoritized identities (such as women and racial/ethnic minoritized students) who are not directly admitted into the [SCHOOL OF ENGINEERING], but instead are admitted to the L&S division. Students not directly admitted will later have the opportunity to re-apply to the [SCHOOL OF ENGINEERING] after strengthening their application and preparation. As such, there is a critical opportunity to promote the pathways for women and students with other minoritized identities into the field of engineering through facilitating the process for L&S students in re-applying to the [SCHOOL OF ENGINEERING].

The 2019 First Year Summer Experience (FYSE) program was designed to strengthen and facilitate pathways into the field of engineering through assisting and supporting [UNIVERSITY]’s L&S students who are interested in studying engineering, but were not directly admitted into the [SCHOOL OF ENGINEERING].

Overview of the FYSE Program

The First Year Summer Experience (FYSE) program is a three-week summer orientation program focused on the development and strengthening of math-intensive engineering problem-solving skills. Two weeks of the program are residential, while the week prior is online-based preparation. Recruitment and selection of participants is geared toward inclusion of women, racial/ethnic minorities, and first-generation college students who were not directly admitted into the [SCHOOL OF ENGINEERING]. The 2019 program served a cohort of 21 first-year female

¹ [SCHOOL OF ENGINEERING] engineering coursework relies heavily on foundational mathematics skills, and the strengthening of mathematics skills can facilitate student success in the [SCHOOL OF ENGINEERING].

students who applied to study engineering but were admitted to the Division of Letters and Sciences, while also providing student leadership and professional development opportunity to six *[SCHOOL OF ENGINEERING]* engineering students. All participants and student leaders identified as women.

One of the main goals of the FYSE program was to strengthen engineering-related mathematics skills, with particular focus on pre-calculus and the application of engineering problem solving. The FYSE program was also designed to stimulate students' interest in the field of engineering. Each day, students participated in several classroom and laboratory hours of math-intensive curriculum aligned with practicing and strengthening engineering problem-solving skills. The coursework was taught by a university faculty member and doctoral student, and assisted by student teaching assistants. FYSE participants were given homework assignments, lab work, quizzes, exams, and an engineering-related group project with a final presentation. Upper-level engineering undergraduate students were hired as residential tutors to assist students each week night, providing guidance and support on homework assignments and projects, in addition to general support in the students' residence facility.

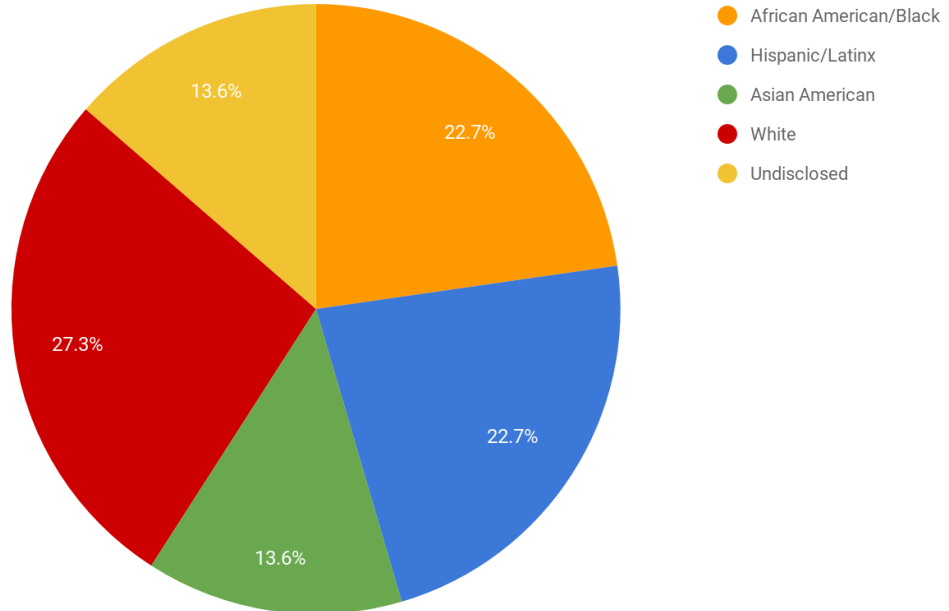
In addition to the academic components, the FYSE program was designed to cultivate community and a network of support among each FYSE cohort. Teamwork was strengthened through various team-building activities, such as a group challenge course, visits to engineering facilities and labs on *[UNIVERSITY]*'s campus, field trip to Washington, DC to see the Apollo 11 Tribute, participation in the NearSpace Program Balloon Launch, and recreational activities. Furthermore, the FYSE program assisted in facilitating students' acclimation, exposure, and access to the *[SCHOOL OF ENGINEERING]* and the *[UNIVERSITY]* campus. Students participated in a series of seminars featuring an open dialogue with the Deans of the *[SCHOOL OF ENGINEERING]*, Aerospace faculty member, their Letters & Sciences Division academic advisor, and the *[SCHOOL OF ENGINEERING]* transfer coordinator. These sessions provided a unique opportunity for students to have access to *[SCHOOL OF ENGINEERING]* resources and to begin developing a strong network of support, while beginning to prepare for the next steps of entry into the engineering major.

The 2019 FYSE Program was funded in part through a generous grant from the Maryland Space Grant Consortium and supported and run through the *[SCHOOL OF ENGINEERING]*'s Women in Engineering Program office. The entirety of the program was of no cost to participants, in an effort to best support underrepresented student populations (women and racial/ethnic minoritized identities) in strengthening mathematics skills for and building community within the study of engineering.

Participant Overview

Twenty-four students were admitted to participate in the 2019 FYSE Program and 21 of those students attended. All participants identified as women, and all participants were admitted to the Division of Letters and Sciences at the *[UNIVERSITY]*, but initially applied to and are interested in majoring in engineering. The figure below displays the racial/ethnic demographics of the 2019 cohort:

Figure 1: Racial/ethnic demographics



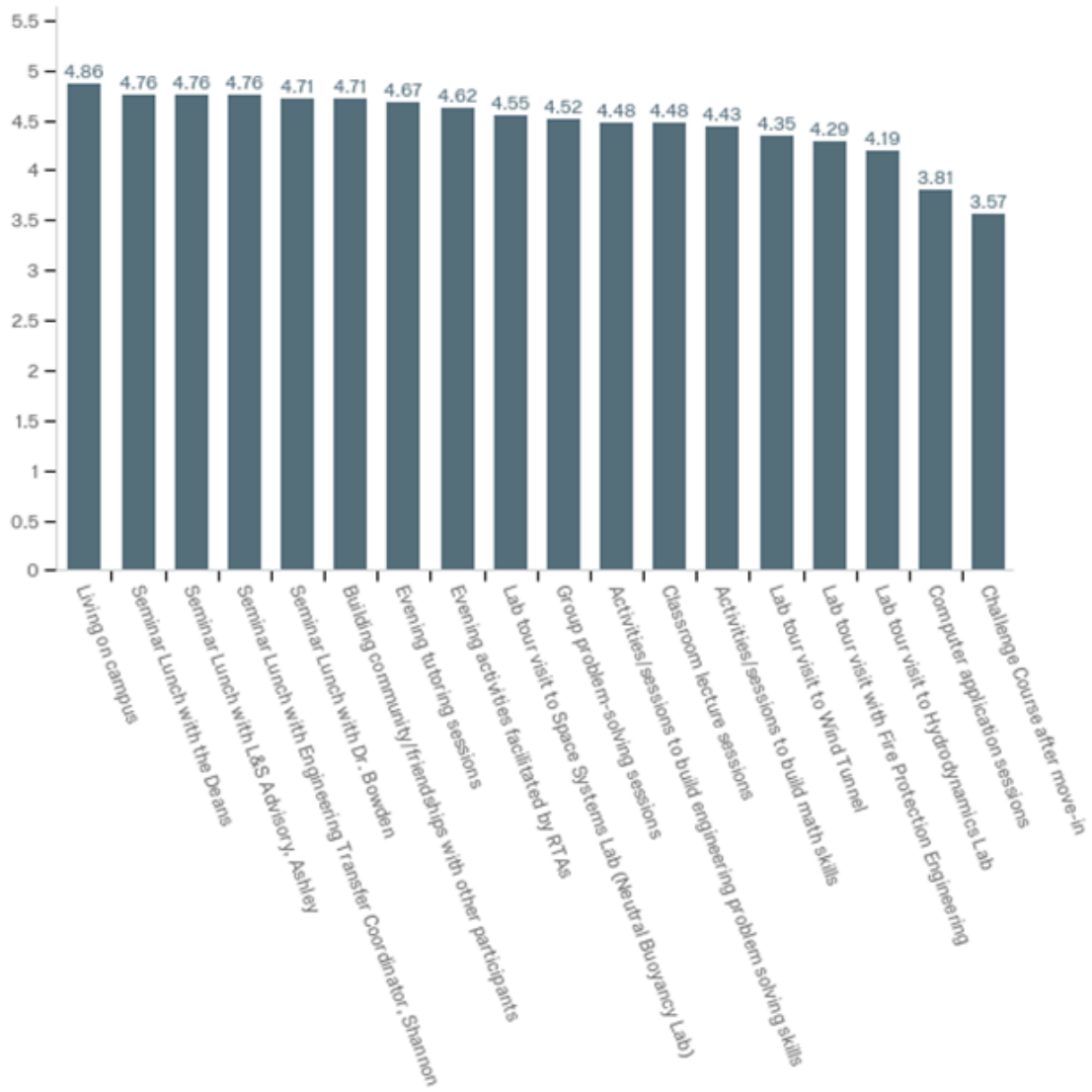
Program Evaluation Outcomes

At the conclusion of the program, all participants were asked to complete an anonymous survey evaluation of the FYSE program and their experiences as participants. All 21 participants opted to complete the survey.

Participants were asked to rate the value of the program components and activities on a five-point Likert scale (1: Low value to 5: High value). Figure 2 displays an overview of these results (based on mean). On average, students rated the following components of the program with a score of 4 or higher, indicating attribution of personal value on the activity:

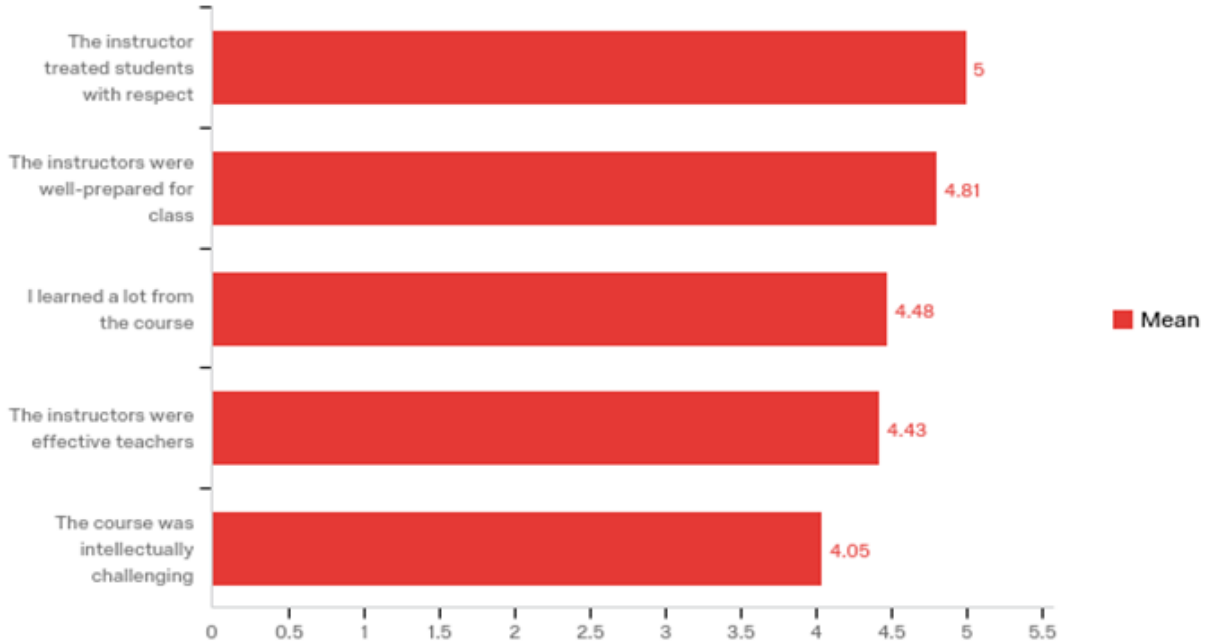
- Living on campus
- Seminar lunch with the Deans
- Seminar lunch with L&S advisor
- Seminar lunch with Engineering transfer coordinator
- Seminar lunch with aerospace faculty member
- Building community/friendships with other participants
- Evening tutoring sessions
- Evening activities facilitated by RTAs
- Lab tour visit to Space Systems Lab
- Group problem-solving sessions
- Activities/sessions to build engineering problem solving skills
- Classroom lecture sessions
- Activities/sessions to build math skills
- Lab tour visit to Wind Tunnel
- Lab tour visit for Fire Protection Engineering
- Lab tour visit to Hydrodynamics Lab

Figure 2: Value of Activities

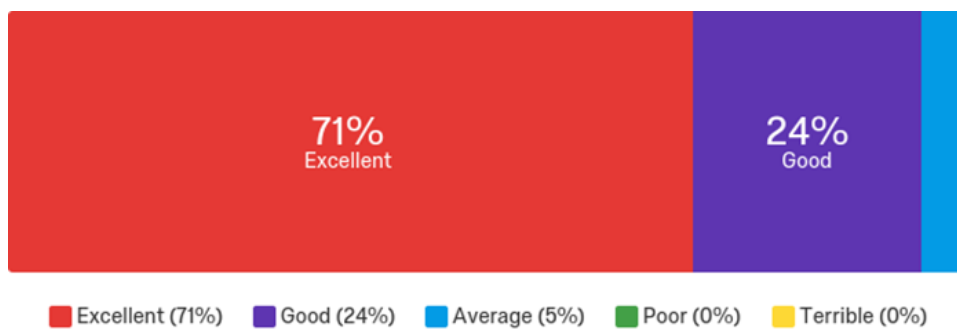


Participants were asked to evaluate the classroom component of the FYSE course on a five-point Likert scale indicating the extent to which they agree or disagree with the following statements (1 – Strongly disagree; 5 – Strongly agree). Figure 3 displays these results.

Figure 3: Evaluation of FYSE classroom component



Participants’ overall evaluating rating of the FYSE 2019 Program:



In addition to the quantitative data collected, qualitative responses were also collected on the survey questionnaires. The following section provides a select summary of responses to questions posed in the survey questionnaire:

General comments:

“I feel much more confident in my decision to go into engineering and not receiving admittance to the engineering school. I have also made many valuable contacts.”

“It’s really helpful with refreshing what you’ve learned in math and helps strengthen your skills. it also allows you to have connections and friends before the school year starts.”

“It is a very good investment of time, especially since it takes place during the least eventful summer of our academic careers.”

“It allowed me to meet many other women who share the same interests”

“It is really fun, but you get to learn as well. It also helps me see what college will be like, so it is a nice transition.”

“It really helps you get ahead in terms of knowing your way around campus, coming in with a social group, and being able to take an engineering class ahead of time.”

“Applying and completing this program is one of the best decisions I have ever made. Thank you so much for allowing me to have this opportunity.”

Why did you participate in the FYSE Program?

“I participated in FYSE because I found that it would be a valuable program to jumpstart my academic pursuits in college and help with transitioning into my intended major.”

“I wanted to take ENES100, have the chance to make friends in a similar situation to me, prepare for engineering in college, visit labs, and get any further questions I have answered.”

“I wanted to participate in FYSE to strengthen my math/problem solving skills for a great base and introduction into engineering. Although I am still undecided as to whether I want to continue on with engineering I wanted to participate to fully see if it was still something I was interested in.”

“To strengthen mathematical and engineering skills, as well as, to build more personal relationships with my peers.”

“To get a head start with engineering and math, as well as knowing campus and people on it.”

Did participation in the FYSE Program meet your expectations? Why or why not?

“It greatly exceeded my expectations. The teachers, students, and RTAs were all very friendly and helpful. I learned a lot about being a transfer student, the engineering school, and engineering in general. I feel more confident about my current situation and pursuing engineering.”

“Yes. I believed it excelled my expectations. The course content was very helpful and I learned much more than I expected with respect to engineering and math.”

“Yes, because it exposed me to engineering math skills but was more work than activities that I anticipated.”

“Yes, because I was able to learn more concepts, but also I was able to talk to more people and learn from them as well.”

“It exceeded my expectations because it educated me more about the actual applications of engineering I had first thought and also showed me it’s ok to make mistakes.”

“It surpassed my expectations, it was more challenging than I thought but in a good way.”

What is the greatest strength of the FYSE Program?

“The greatest strength of the program is the community it brings together and the resources it provides.”

“I believe the greatest strength is preparation for what to expect coming into [UNIVERSITY] in the fall in hopes to transfer into engineering in the following semesters.”

“It’s faith in us as future engineers. What pushed us the most is their desire to see us succeed and to help us succeed.”

“The collaboration between every participant and the teachers to make the program successful. Allow students to experience first hand about living on campus and studying for classes.”

“That it gives you a bit more resources and exposure than normal students may receive.”

“Meeting other students who are in the same situation as you and being able to make friends before college officially starts.”

In addition to the survey data collected, all FYSE students will be tracked longitudinally for original major, current major, semester-to-semester retention, graduation, and years to graduation. Long-range indicators of these outcomes are increased persistence in engineering (transfer into engineering rates, semester to semester retention rates, and ultimately graduation rates), course taking patterns, academic success evidenced by GPA and course passing rates, increased sense of self-efficacy, and subsequent involvement in STEM programs, including undergraduate research or internship opportunities. Longer term success will be defined by engineering degree attainment.

The First Year Summer Experience 2019 Program was funded through a generous grant from the Maryland Space Grant Consortium, as well as supported by the [SCHOOL OF ENGINEERING].

References

Ackermann, S. P. (1991). The benefits of summer bridge programs for underrepresented and low-income transfer students. *Community/Junior college quarterly of research and practice*, 15(2), 211-224.

American Physical Society [APS]. Fraction of bachelor's degrees earned by women, by major. (2015). Source: IPEDS Completion Survey.

Gleason, J., Boykin, K., Johnson, P., Bowen, L., Whitaker, K., Micu, C., ... & Slappy, C. (2010). Integrated engineering math-based summer bridge program for student retention. *Advances in Engineering Education*, 2(2), 1-17.

Kallison Jr, J. M., & Stader, D. L. (2012). Effectiveness of summer bridge programs in enhancing college readiness. *Community College Journal of Research and Practice*, 36(5), 340-357.

National Science Foundation [NSF] (2018). National Science Board Science and Engineering Indicators 2018. Science and Engineering Degrees, by Race/Ethnicity: 2000-2015. Arlington, VA. <https://nsf.gov/statistics/2018/nsb20181/figures>.