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College-Wide First Year and Career Mentorship Programs

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College-Wide First Year and Career Mentorship Programs

Introduction

The College of Engineering at the University of New Haven began two formal mentorship programs in spring 2020 with the help of a for-profit company named Mentor Collective. The First-Year Mentorship Program is designed for students entering the university and the Career Mentorship Program is designed for juniors and seniors. The programs were sponsored by a generous gift from Sikorsky, a Lockheed Martin Company. This paper focuses particularly on the impact of the First-Year Mentorship Program on the first to second year retention of engineering and computer science students.

Within engineering disciplines, the national average for female undergraduate students enrolled in engineering programs was about 22.7% during 2018, and the national average of non-white or non-Asian students enrolled in undergraduate engineering programs was 35.2% [1]. For students enrolled in computing programs, the data is similar: about 19.9% are female [2] and 22.6% are non-white or non-Asian [1]. Some colleges of engineering have offered either formal or informal mentorship programs and these have generally resulted in positive outcomes with respect to retention [3]. Mentoring can contribute positively to success in college and in careers, with many mentoring programs developed specifically to increase the retention or career-readiness for low-income [4,5], female [6-10], or minority students in STEM degrees [8,10,11].

The structure of mentoring programs designed for first-year student retention varies. Many programs are designed alongside a first-year transition course or bridge program, linking mentorship with structured conversations or resources [4-5, 12-13]. The integration of peer mentoring into required coursework makes implementation easier as all students receive both mentorship and transition support. However, the mentoring experience can be negatively impacted in this model, especially if students do not appreciate the benefit of the college-transition or career exploration course itself; this is demonstrated by participant quote, “My PA is the only good thing about the FIG [First-year Interest Groups] groups. John is very enthusiastic and encouraging. It's a pleasure to know him, and I'm glad he's my PA.” [13, pp. 7]. Non-curricular large-scale mentoring programs also exist, usually setting desired meeting times such as communication once a week [8] or suggesting discussion topics by month [9]. Programs may include peer mentors, faculty mentors, and/or industry mentors for first year students, and may vary from individual mentorship (one mentor assigned to one mentee) to group mentorship (one mentor assigned to a group of students who meet as a group). Of the publications reporting the retention data of mentoring programs, most have reported increased retention rates for mentoring participants [13-14]. However, it isn't clear exactly which part of multi-faceted mentoring and support programs results in this increase. Washington suggests mentorship programs develop and increase students' social community, defined with attributes such as students' connectedness, resilience, communities of practice, social capital, and satisfaction which all contribute to retention [10].

Career or industry mentoring programs are typically setup to provide undergraduate students workforce preparedness, soft-skill development, and/or career exploration [15,16]. While many capstone or senior-design courses integrate industry connections, the industry mentor role typically looks more like a "client" or "advisor" role for the academic project [17,18]. Broader career mentorship is usually not affiliated with a class and can range from

informal on-demand mentoring [16] to formal structures such as setting a minimum length of meeting time each month or requiring formal agenda/minutes from mentor meetings to be submitted [15]. As alternatives to such formal programs, many career-based mentoring programs have evolved into e-mentoring. One example of an email-based mentoring program found both peer-to-peer mentoring and career-based mentoring were successful online, described as low-maintenance with positive benefits and flexibility [7]. Muller suggest that students may feel less intimidated posing questions via email with a career-based mentor than in-person or over the phone [6]. Other advantages of e-mentoring included the ability to overcome synchronous time constraints and/or geographic constraints, increasing the potential mentor pool.

Methods

Recruitment of Mentees and Mentors

Participation in the mentorship programs was voluntary and open to all undergraduate students in the Tagliatela College of Engineering. Students admitted to the college as incoming first-year students were invited to participate in the first-year program as early as March of each year. The program was promoted in multiple ways:

1. It was highlighted during Accepted Student Days when admitted students participated in recruitment events to familiarize them with the campus, the college and their programs.
2. Students were encouraged to sign up for the program during summer orientation and during fall orientation when they arrived on campus.
3. Instructors of first-year courses were asked to promote the program to students in their courses.
4. E-mail was sent to all first-year students with details of how to sign up for the program.

First-year students were informed that participation in the program could help them quickly learn about the campus, their programs, their faculty, and so on. The sign-up process for mentees was also quick. They had to complete a brief profile online and indicate their preferences regarding the characteristics of their mentor.

Sophomores were recruited to serve as mentors to the first-year students. Mentor recruitment was done via email, through advisors, and through instructors of sophomore courses. Mentors were not paid or otherwise compensated. The sign-up process for mentors was more involved than for mentees. In addition to completing a brief profile indicating their majors and other characteristics, they had to go through a 30-minute online module designed to train them on how to be effective mentors. Mentors were also asked how many mentees they would be willing to mentor. Only mentors who completed the training module were matched with mentees.

Juniors and seniors were recruited as mentees for the career mentorship program. Recruitment was done via email, through advisors, and through instructors of junior and senior classes. They were informed of the value of having a mentor who was a professional in industry to facilitate them in securing internships and jobs after graduation. As with mentees in the first-year program, the sign-up process for mentees of the career program was also quick requiring them to complete a brief profile online and indicating the preferred discipline and characteristics of their mentor.

Professionals in industry were recruited to serve as mentors in the career program. Recruitment was done through an email from the dean to alumni within about 10 years of graduation, as well as to members of the various advisory boards in the college and its departments. As with the first-year program, mentors had a lengthier enrollment process that required them to enter a brief profile followed by a 30-minute online training module. Only mentors who completed the training module were matched with mentees.

Platform for Communication

A web-based platform developed by Mentor Collective was used for mentees and mentors to log conversations, access resources, and obtain contact information and other salient details about their counterpart. Once mentees completed registration and mentors completed both registration and training, the platform suggested appropriate matches between mentees and mentors. These matches were reviewed by staff at Mentor Collective before being confirmed. Once confirmed, the mentees and mentors were matched in an initial text message chain to introduce the pairing. Paired mentees/mentors were freely able to communicate via their preferred method of contact; the predominant mode of communication was text messaging. Text messages were routed through a relay that allowed for tracking exchanges and masked the phone numbers of the mentors and mentees.

To preserve confidentiality and privacy in the mentee/mentor relationships, the text messages sent through the relay were not visible to staff at Mentor Collective or the University of New Haven. After each conversation, mentors and mentees were expected to log the conversation in the web-based platform indicating what topics were discussed and their mode of communication. In addition, mentors had the ability to raise insight flags when they learned something that was concerning or needed additional advice to what they could provide. Default insight flags included academic struggles, financial concerns, depression, Covid-19, difficulty finding a job or internship, and other. The insight flags raised by mentors were monitored by a coordinator in the college and at the company and acted upon as needed. Typically, additional resources were provided to the mentors to share with mentees. The privacy of the mentee-mentor relationship was maintained, and no direct interventions were made by the coordinators. If paired mentees/mentors had not logged a conversation in a given month according to expectations, the web-based platform reminded the pair to log a conversation and offered help in reconnecting the pair if needed.

The platform provides several dashboards containing the following information for those monitoring the program:

- Number of mentees and mentors matched over time
- Number of distinct conversations logged over time
- Number of total peer-to-peer text messages
- Number of insight flags raised by mentors over time
- The names of mentees and mentors and the type of insight flag raised by the mentor

In fall 2022, the dashboards were improved to provide plots over selectable date ranges for the following additional items: the number of mentees and mentors who were invited, registered, completed matching surveys and were matched, the average conversations per pair, the number of mentees with 3+ conversations logged, the number of pairs using the SMS relay, and the average SMS texts exchanged per pair.

Results

Statistics of Participants

The mentee and mentor “funnels” that show the numbers of people who were invited, registered, completed the matching survey and were matched are shown in Table 1 for the programs that started in 2020 and 2021. Students who were invited to the First Year Program included those who were accepted to the college; not all of them enrolled. Participation of both mentees and mentors in the First Year Program was much stronger in 2021 than in 2020. While the participation of alumni and professional mentors in the Career Program was stronger in 2021 than in 2020, the participation of upper-class student mentees was significantly lower in 2021 than in 2020. We hypothesize that this was due to Covid induced fatigue, as repeated efforts to get juniors and seniors to participate in the program were not successful.

The proportion of eligible students who participated in the program are shown in Table 2. Based on other institutions that Mentor Collective works with, our participation rates are very strong except for the Career '21 program. The breakdown of the number of mentees who participated in the 2020 and 2021 First Year and Career programs by gender and race/ethnicity are shown in Figure 1 and the percentage breakdowns are shown in Figure 2.

The following observations are made from Tables 1 and 2 and Figures 1 and 2:

- Males represented 68-79% of the mentees.
- Females represented 20-30% of the mentees.
- Those who reported their race as Black represented 10-14% of the mentees.
- Those who reported their ethnicity as Latinx represented 12-15% of the mentees except for the 2021 Career Program in which this percentage dropped to 4%.

Table 1. Mentee and Mentor “Funnels”

Category	Mentees				Mentors			
	First Year '20	First Year '21	Career '20	Career '21	First Year '20	First Year '21	Career '20	Career '21
Invited	220	478	192	270	307	278	4227	4230
Registered	105	136	135	86	56	160	55	61
Completed Survey	96	120	130	67	37	122	37	52
Matched	95	120	123	54	34	70	34	30

Table 2. Participation Rates in the Mentorship Programs

Program	No. of Students Who Participated	No. of Eligible Students	Percent Participation
First Year '20	95	179	53.1%
First Year '21	120	165	72.7%
Career '20	123	192	64.1%
Career '21	54	270	20.0%

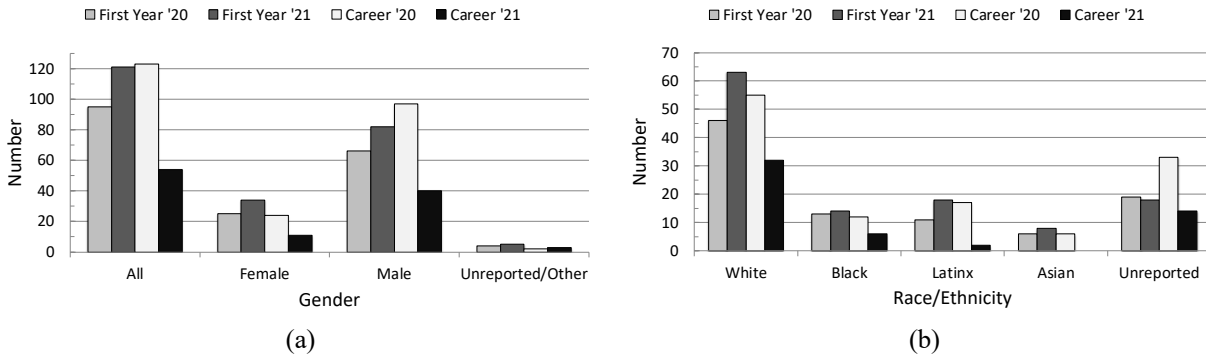


Figure 1. Breakdown of mentee counts by: (a) Gender; (b) Race/ethnicity

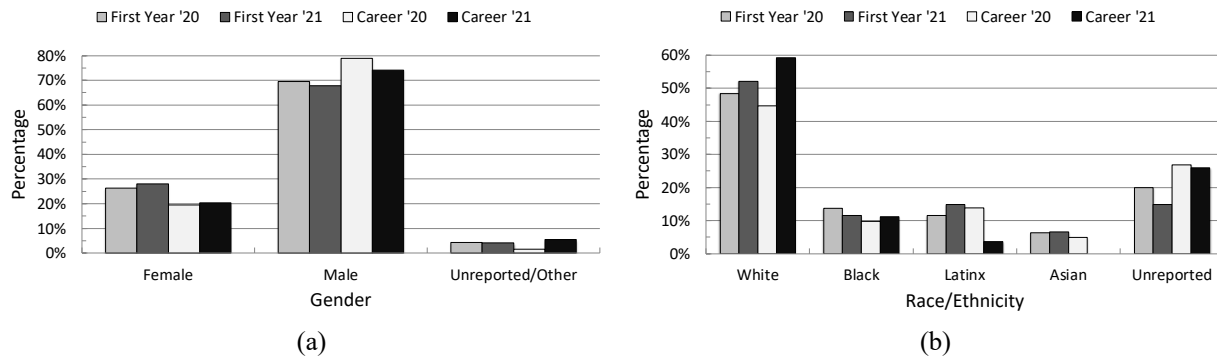


Figure 2. Breakdown of mentee proportions by: (a) Gender; (b) Race/ethnicity

- Those who reported their race as Asian represented 5-7% of the mentees except for the 2021 Career Program in which this percentage dropped to 0%.
- A rather large proportion of mentees (15-27%) did not report their race/ethnicity.

The percentages of Black, Latinx and Asian students who participated as mentees is similar to the percentages of these groups within our general student population.

The breakdown of the number of mentors who participated in the 2020 and 2021 First Year and Career programs by gender and race/ethnicity are shown in Figure 3 and the percentage breakdowns are shown in Figure 4. The following observations are made from these figures:

- Males represented about 70% of the student mentors in the First Year Program, and 50-87% of the professional mentors in the Career Program.
- Females represented 18-27% of the student mentors in the First Year Program, and 35% of the professional mentors for the 2020 Career Program. For the 2021 Career Program the professional female mentors were only about 7%. This drop in female professional mentors may be due to the family pressures on working women during the pandemic, but has not been explored further.
- Those who reported their race as Black represented 9-21% of the mentors. The number and percentage of professional Black mentors in the 2021 Career Program dropped to less than half that in the 2020 Career Program.
- Those who reported their ethnicity as Latinx represented 6-15% of the mentors except for the 2021 Career Program in which no Black professionals participated as mentors.

- Those who reported their race as Asian represented 3-6% of the mentors.
 - A rather large proportion of mentors (20-26%) did not report their race/ethnicity.
- Mentee/Mentor Interactions

The number of conversations, SMS text messages exchanged, and flags raised in the various programs are shown in Table 3. The 2021 year is not yet complete. As a part of logging their conversations, mentors and mentees were asked to report on the main topics of their conversations. Results of the first year and career program reported topics are shown in Tables 4 and 5. In both programs, academics was discussed by many mentees and considerable time was also spent on mentees and mentors getting to know each other. School life was discussed by many in the First Year Program. The results of conversation topics recorded by both Forbes [16] and Anderson [7] in industry mentorship programs show similar trends, with a significant portion of the conversations focused on getting to know the mentor/mentee or personal background, and other common topics including networking, the student's career plans, and academics.

The number of flags raised by mentors related to various issues are shown in Figure 5. The greatest number of flags raised by professional mentors in the Career Program were related to mentees difficulty finding internships and jobs. We know that this was a particularly acute problem during the Covid-19 pandemic. A significant number of flags in both programs were raised with respect to academic struggles faced by mentees.

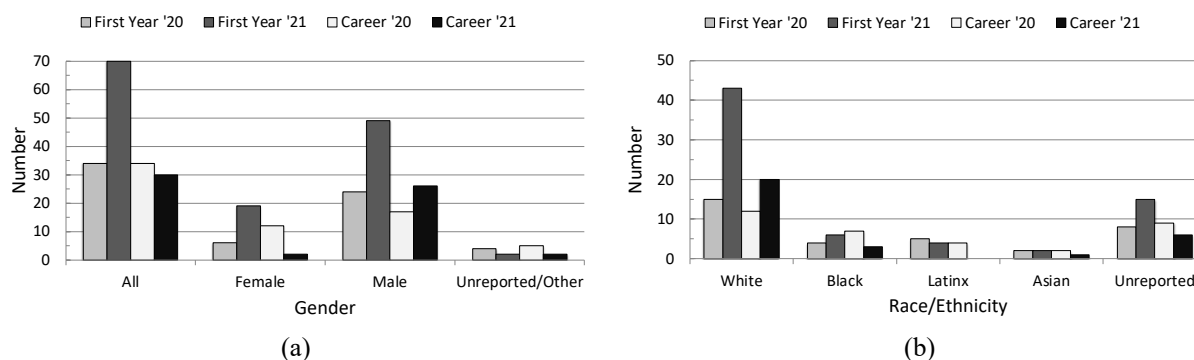


Figure 3. Breakdown of mentor counts by: (a) Gender; (b) Race/ethnicity

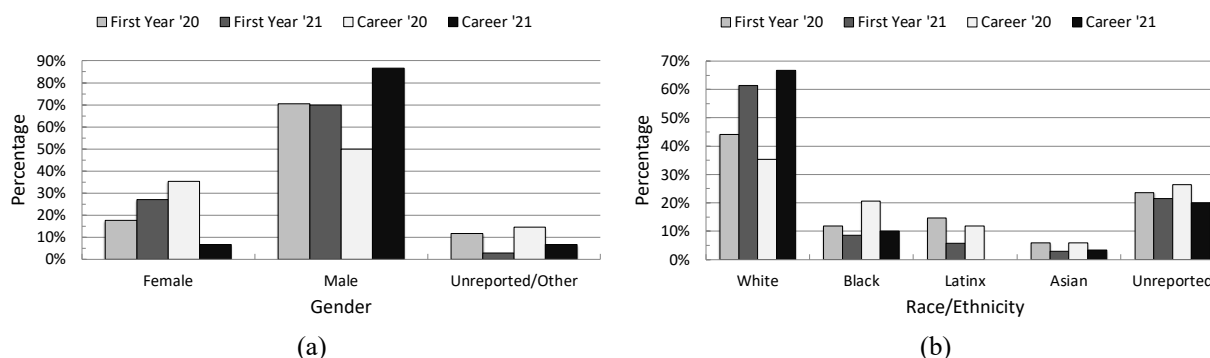


Figure 4. Breakdown of mentor proportions by: (a) Gender; (b) Race/ethnicity

Table 3. Counts of Mentee/Mentor Interactions

Type of Interaction	First Year '20	First Year '21	Career '20	Career '21
# of conversations	557	47	667	277
# of SMS exchanged using relay	3384	2222	2678	442
# of flags raised	16	11	47	12

Table 4. Proportion of First Year Program Mentees Who Discussed Each Topic with Mentors

Topic	First Year '20	First Year '21
Academics	30.6%	21.1%
School Life	25.9%	16.5%
Getting to Know Each Other	20.4%	18.4%
Activities	7.4%	10.1%
Staying Balanced	7.4%	8.3%
Career	4.6%	3.7%
Other	3.7%	22.0%

Table 5. Proportion of Career Program Mentees Who Discussed Each Topic with Mentors

Topics	Career '20	Career '21
Academics	14.3%	19.3%
Getting to Know Each Other	12.0%	15.7%
Career	7.5%	2.4%
Resumes	7.5%	8.4%
Networking	6.6%	6.0%
School Life	6.0%	4.8%
Staying Balanced	6.0%	1.2%
Activities	5.7%	4.8%
Graduate School	5.7%	4.8%
Interviewing	4.6%	3.6%
LinkedIn	2.9%	4.8%
Career Fairs	2.6%	4.8%
Research Opportunities	2.3%	3.6%
Other	16.3%	15.7%

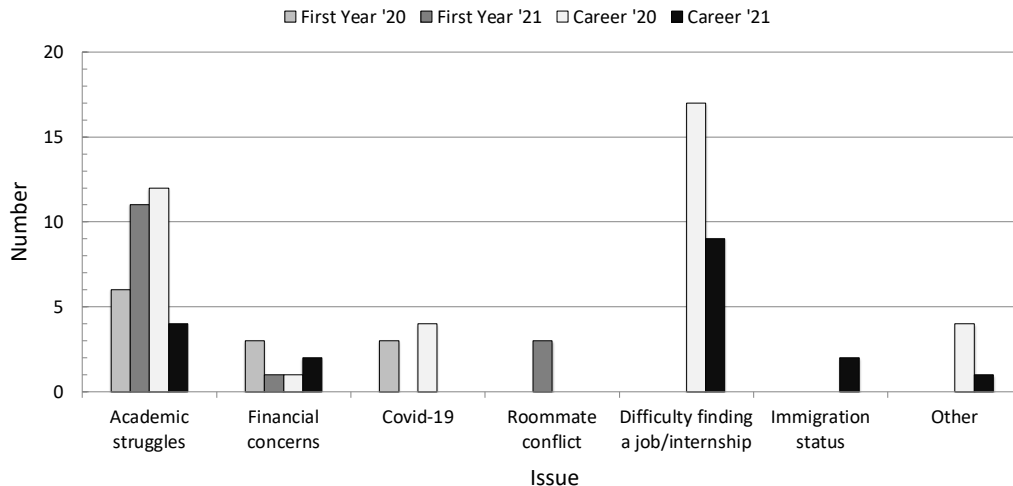


Figure 5. Number of flags raised on various issues

Impact of the First Year Program on Retention

The impact of the mentorship program on student retention was evaluated by comparing the first to second year retention of students who participated in the 2020 First Year Program to that of students who refrained from participating in the program. Both retention within the College of Engineering as well as retention within the university were considered. The impact of the program on different student demographics such as gender and ethnicity were also assessed.

Figures 6 and 7 show the first-year retention by gender and race/ethnicity, respectively. The following observations are made:

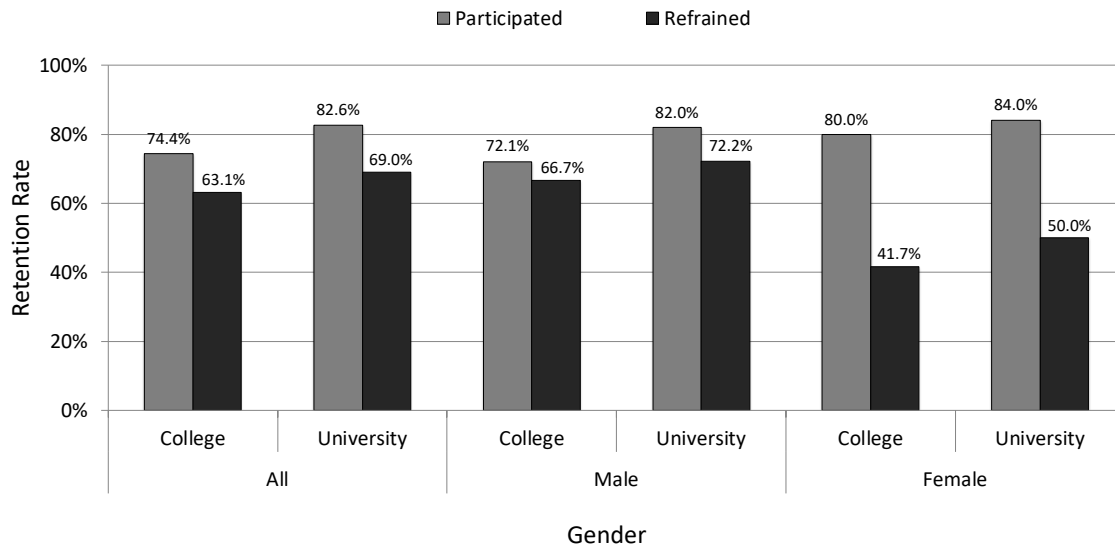


Figure 6. Fall 2020 to Fall 2021 retention in the college and the university by gender

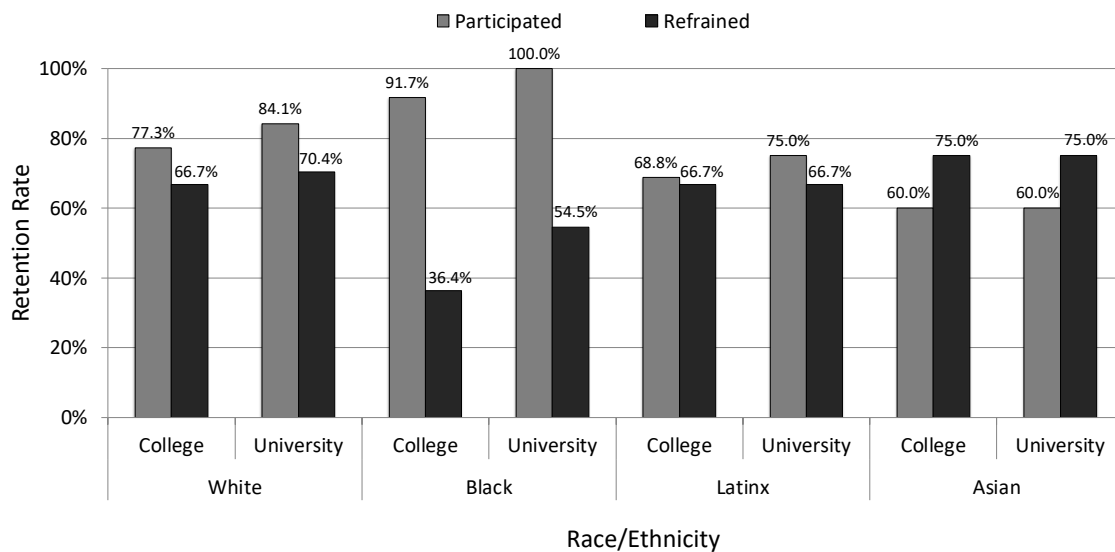


Figure 7. Fall 2020 to Fall 2021 retention in the college and the university by race/ethnicity

Table 6. Two Sample One-Sided Z Test for Significance

Group	Difference in College Retention Significant?	Difference in University Retention Significant?
All students	No ($p = 0.056$)	Yes ($p = 0.020$)
Male	No ($p = 0.248$)	No ($p = 0.093$)
Female*	Yes ($p = 0.026$)	Yes ($p = 0.039$)
White	No ($p = 0.124$)	No ($p = 0.055$)
Black*	Yes ($p = 0.008$)	Yes ($p = 0.014$)
Latinx*	No ($p = 0.626$)	No ($p = 0.499$)
Asian*	No ($p = 0.881$)	No ($p = 0.881$)

*Used Fisher's Exact Test

- The retention rate was higher for all students who participated in the program compared to those who refrained from participating except for Asian students. It is not apparent why the anomaly was observed for Asian students; the number of Asian students was small.
- The mentorship program was most effective in retaining women and Black students.

Two sample one-sided hypothesis tests at the 0.05 significance level were conducted to test the following hypothesis:

H_0 : Retention rate for students who participated in the program \leq Retention rate for students who did not participate in the program

H_a : Retention rate for students who participated in the program $>$ Retention rate for students who did not participate in the program

When the sample sizes were small, Fisher's Exact Test was used. The results of the hypothesis tests are shown in Table 6. The improvement in first-year retention within the college and the university for those who participated in the 2020 First Year Program is statistically significant at the 0.05 significance level (i.e., p -value less than 0.05) for female and Black students. When all students are considered together, the improvement in retention within the university for those who participated in the program is statistically significant, and just fails to be significant for retention within the college ($p = 0.056$).

The percentage of mentees in the 2020 First Year Program who served as mentors in the 2021 First Year Program was 87.5%. This high percentage indicates that the 2020 mentees perceived the program to be valuable and wanted to facilitate the experience for new students entering in 2021. The trend of requesting mentees who complete their year to become mentors in peer mentoring programs is not uncommon, as demonstrated by other programs [5, 13], though their reported results do not include the percentage who transition from mentee to mentor for comparison.

Feedback from Surveys

An online survey was administered to mentees and mentors. Questions on the survey asked whether mentees were satisfied with mentors and vice versa and whether they would recommend the program to others. A 7-point scale with 1=Lowest to 7=Highest was used. In Fall 2021, two additional questions were added to the survey administered to mentees asking whether they were satisfied with the online platform and whether they found the mentorship program valuable. A 10-point scale was used for these additional questions with 1=Lowest to 10=Highest. Responses

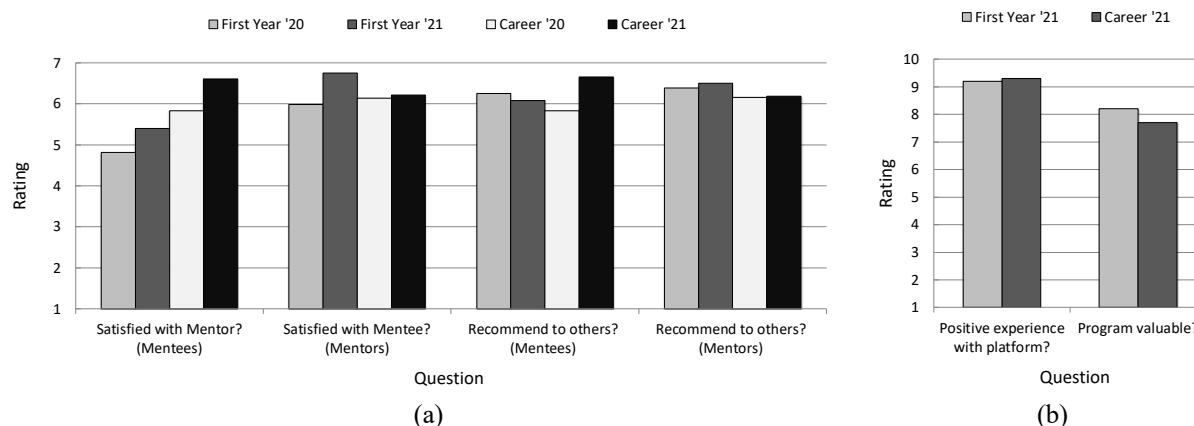


Figure 8. Satisfaction ratings (a) mentees and mentors; (b) mentees

from the surveys are shown in Figure 8. The satisfaction ratings are generally strong with the lowest values being mentee ratings of student mentors in the 2020 and 2021 First Year Programs.

Reflections on the Platform and Partnership

While mentorship programs are highly beneficial, they often require significant support to match and support all of the one-on-one matches. The program described herein was supported by the Dean and Associate Dean of the College of Engineering and a faculty member, alongside an assigned staff member from Mentor Collective. In general, the support team meets every other week briefly to review the program timeline, numbers, next-steps, and any concerns that have come up. Without the platform created by Mentor Collective, our college would need significant additional faculty or staff support and would not be able to include features like the text message relays for anonymity, repeated mentor training opportunities, automated matching with review, and the data captured about the participants and mentorships.

While the support team has attempted to host in-person events to bring the mentors and mentees together, these efforts were not possible during the first year of the programs due to COVID, and events during fall 2021 had low engagement from students. We hope to expand the number of in-person opportunities we sponsor to bring the mentors and mentees to meet face-to-face, including a kickoff event each semester to hopefully encourage more participation and connection from the start of each program.

Finances to Sustain the Program

Sustaining the program will require funding to support the partnership with Mentor Collective. Increased revenue from the improved retention justifies university investment in the program. For example, the improved retention at the university of 34% from year 1 to year 2 (84% for those who participated vs. 50% for those who refrained) for the 25 women students who participated in the program in 2020-21 yields additional tuition revenue from 8 more students in year 2. Using the net tuition rate and the average financial aid offered to students at the university, this amounts to an increased revenue of over \$100,000 in year 2 from women students alone. When Black students are added in, the increased revenue is even greater. Further, if these students are retained until graduation, then the university will further benefit from increased revenue in years 3 and 4. This increased revenue more than offsets the cost of the partnership with Mentor Collective.

Conclusions

Two systematic mentorship programs were deployed in the Tagliatela College of Engineering at the University of New Haven. The First Year Program provided peer-to-peer mentoring to incoming first-year students by sophomores, and the Career Program provided mentoring to juniors and seniors by professional engineers. Of particular significance is that both programs were launched during the Covid-19 pandemic when many students felt especially isolated. Participation in the programs was voluntary.

The First Year Program had strong participation with 53-73% of eligible students participating. The impact of the program on the retention of students from fall 2020 to fall 2021 was strong, with 77.3% and 84.1% of students who participated being retained at the college and university, respectively, compared to 66.7% and 70.4% for students who did not participate in the program. The improvement in retention rate was especially dramatic for female students and Black students. For female students, 80.0% and 84.0% of those who participated were retained at the college and university, respectively, compared to 41.7% and 50.0% for students who did not participate in the program. For Black students, 91.7% and 100% of those who participated were retained at the college and university, respectively, compared to 36.4% and 54.5% for students who did not participate in the program.

Feedback provided by mentees and mentors regarding the mentorship programs was very positive with most indicating that they found the programs valuable and would recommend them to others. They also had a very positive experience with the web-based platform used for the programs.

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