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A First-Year Engineering Mentoring Program Service Blueprint Analysis: Insights and Lessons Learned in Program Design and Implementation

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Introduction

The purpose of this exploratory "Tricks of the Trade," research paper is analyzing a peer mentoring program developed to support first-year students. Through the use of the service blueprints' design-based methodology, the program's impact, structure, and perceived impact on student engagement and retention are investigated. Insights drawn from student reflections, a graduate student and a student coordinator, who have remained engaged with the program over multiple years contribute to a deeper understanding of the program. This offers a view through the eyes of students who have seen several iterations of the program and have participated through different roles. Now in leadership positions, these students collaborate with the program's director and manager to support the implementation and ongoing development which is designed to remain dynamic as it is continuously improved to meet the evolving student needs.

Ensuring first year retention is a critical priority for all institutions, student withdrawals, transfers, and dropouts can frequently be attributed to limited academic support, insufficient engagement, and challenges that arise from the transition from high school to college [6]. A student's first year at a university often determines whether they remain, continue, succeed in pursuing, and graduate their degree. This can be said of students from high school or transfer students as student engagement academically, socially, and professionally can be described as the foundation for maintaining retention. Within this context, mentoring programs are essential to fostering support networks, community, motivation, and a sense of belonging [7]. These factors contribute to students' development by providing essential support during the first year of university.

Developing a strong sense of belonging at institutions correlates to students' perseverance, further showcasing the importance of university intervention and initiatives [7]. In this instance peer mentoring programs provide students with the opportunity to connect with others, promoting engagement, and participation through purposeful and targeted strategies. Peer mentors provide mentees with guidance, support, and assistance as they are at the forefront of a peer mentoring program due to their direct and continuous contact with students [6]. This study addresses internal operational structures, design, and implementations. This is done using the experiences of students, contributing directly to the program's semester by semester evaluations and iterative design.

Through the use of the service blueprints' design-based methodology, the framework and structure of the peer mentoring program can be visualized [4]. The roles and interactions can be mapped,

and pain points can be identified. In combination with student insights, the service blueprint analysis can identify the operational features that most directly support student engagement and retention.

The findings highlight identifying and improving weaknesses, improving efficiency, enhancing collaboration, highlighting existing strengths, and present first-hand experiences gained through direct involvement with the program. The service blueprint that focuses on program design, integrating student perspectives may facilitate the development of similar peer mentoring initiatives at other schools of engineering. The results are intended to offer a framework for guidance and best practices supported by the service blueprint. The research questions guiding this design-based investigation are:

1. What previously unknown service elements emerge through service blueprinting when informed by student mentors' and coordinators' firsthand experiences?
2. How can service blueprinting, augmented by student leader insights, identify areas for redesigning to improve program scalability and long-term sustainability?

Method

Through the use of the service blueprints' design-based methodology, the program's operational structure is mapped out providing a visual aid in accordance with the peer mentoring programs design. Key components and interactions between stakeholders can be identified among everyone involved in the program, from the leadership team, including the director and manager, to the incoming cohorts of mentees [3].

The service blueprint method allows for the visual representation, analysis, and mapping of the peer mentoring programs' operational system [1]. The service blueprint was first introduced in the 1980s for designers, one of the benefits is its adaptability and possible application to different services [2]. Multidisciplinary teams can use this to remain on the same page as all areas are mapped and showcased in a graphic approach [5]. In this instance, the program director and manager work alongside both engineering students who have joined the leadership team, mentors, and program assistants. The service blueprint is composed of three main layers: (1) the *frontstage*, refers to the service as is experienced by users; (2) the *backstage*, is a view from inside consisting of the team dynamics, interactions, and exchanges made by everyone involved; and (3) the *infrastructure*, consists of the technology and any resources necessary for the service.

Program Overview

The peer mentoring program was first established in the Fall of 2021 within the school of engineering at a private four-year university, it was designed and implemented to improve engagement and retention among first year students. It officially launched in the Spring of 2022 with an initial first year student cohort of 30, 9 mentors, and 1 student coordinator that supported the director of the program. Since then, the program has grown in the number of first year students, mentors, student coordinators, and program staff, with the first full year occurring 2022-2023. Every year the program grows in scale and complexity, hence its dynamic design due to its continuous improvements to meet the evolving student needs. This year there are 61 first-year mentees, 17 mentors, 3 program assistants, 1 graduate assistant, 1 student coordinator, an academic advisor, a program manager, and the program director.

The preparation process for each cohort begins prior to the fall semester, where the leadership team works closely with university admissions to identify eligible students. The recruitment phase involves clear and consistent communication through email campaigns and in-person outreach to encourage students to join. Students are provided with a detailed explanation of the program and its benefits. Mentor recruitment occurs early in the spring semester, to ensure interviews and training all occur. It is important to connect with the mentors, learning more about their experiences and methods of leadership. They will be at the forefront of the program and will have continuous one-on-one contact with the mentees.

The applications submitted by possible mentees involve a Qualtrics form, a cloud-based platform used to create, distribute, and analyze online surveys. This is designed to collect further details on their interests, academic goals, and personal preferences. This form is important in matching mentees with upper-class peer mentors, ensuring compatibility. The matching process is crucial, as it ensures that mentors can provide relevant guidance and that mentees would feel supported.
Once the steps mentioned above are completed and mentor training is completed, it marks the official start of the mentoring process and the fall semester. Mentor-mentee meetings take place bi-weekly throughout the semester, with mentors offering one-on-one support tailored to the specific needs of their assigned mentees. These meetings provide guidance on academic challenges, strategies for succeeding in rigorous courses, and advice based on the mentor's personal experiences.

Throughout the semester, the mentoring process is supported by weekly seminars, which are often led by faculty or staff and are designed to support academic and professional development as well as personal growth. These seminars are essential in reinforcing the mentee experience by providing additional tools and strategies for academic and professional success as well as personal growth. Additionally, they allow mentees and mentors to meet one another outside of their bi-weekly

meetings and allow all members of the program to interact; this facilitates relationship-building and aids in creating a community within the program.

A key component of the program is tracking the mentee's engagement. Attendance at both the weekly seminars and bi-weekly mentor-mentee meetings was monitored to ensure active participation and commitment. The program mentors use Qualtrics forms throughout the semester to write about their mentee meetings after each meeting. This feedback provided valuable insights into the mentoring relationships and their meetings, which allowed the program to make necessary adjustments in real time or offer support the moment the mentor was notified it was needed. For example, if a mentee expresses concerns or if mentors report challenges in their meetings, these insights are used to enhance the mentoring process or offer additional support. Feedback from participants, both mentors and mentees, is integral to improving the overall program and shaping the future direction of the mentoring initiative.

By providing consistent academic and social support through peer mentorship, the program plays a critical role in enhancing the academic success, retention, and overall experience of first year students in STEM.

Program Insights

The interactions and touchpoints that allow effective mentoring are between the mentor and the leadership team. The leadership team includes a graduate assistant, a student coordinator, an academic advisor, a program manager, and the program director. As a mentor, there are several touchpoints between the leadership team that facilitate the development and success of the mentoring process. These include weekly team meetings, mentor-tracking, training, Qualtrics forms, Canvas, GroupMe, and outlook emails for communication. These points of contact facilitate the delivery of the mentoring service by connecting mentees to everything the program has to offer.

Training occurs the week before the fall semester over two days, the pertaining documents provide a formal avenue for mentors to fully understand their role. Weekly team meetings give mentors the opportunity to share their interactions with mentees, communicate concerns, and specific mentee interests. Alternative make-up meetings were introduced during the 2024-2025 academic year. When scheduling seminars mentee availability is prioritized, similarly, mentor schedules are used to determine the best time for the weekly meetings. The same problem emerged when creating a schedule, in that not all mentors were available at the same time, which had the potential to create a disconnect within the team. To address this, adjustments were made, these included a second weekly make-up meeting for students unable to attend the primary session. This was led by the graduate assistant to ensure the same content was covered and followed the same structure as the original session, enabling collaboration and interactions amongst the team.

Mentors are required to submit Qualtrics forms 24 hours after meeting with mentees to track a mentee's progress and potential concerns that are later discussed within the weekly team meetings. The leadership team is responsible for identifying any gaps from the Qualtrics forms, brainstorming resources, and advocating for students. These solutions are communicated to mentors to share with their mentees. Discussing these questions and concerns during the weekly team meetings allows mentors to share their own insights with one another. These processes could also occur within the GroupMe group chat, emails, and texts for more urgent matters or quick questions. These touchpoints worked to help the mentoring service run as smoothly as possible, giving the mentors the collective knowledge to share information and resources.

To ensure that the mentors were fulfilling their role, the leadership team created ways of tracking the mentor's completion of their responsibilities including: Qualtrics forms, meeting tracker, and event logistics trackers. The completion of the Qualtrics forms alerts the leadership team about the needs of the mentee while also confirming that they are meeting regularly. To account for the bi-weekly requirement, there are options for the mentor to choose from when tracking their meetings with their mentees, these options are: "Pending," "Off Week," "Scheduled," "Complete," "No Show," and "No Response." This is done via a spreadsheet on Box, for simple access across the program for the leadership team and mentors. In the spreadsheet the Qualtrics form is linked at the top, below it the mentees listed with their mentors. Each week for the semester is listed, and the drop options can be selected per week for each mentee. The leadership team use Sign-Up genius, an online tool used to organize events, for each seminar where the mentors can sign-up to attend, help set up, and tear down. These online systems allow the leadership team to see how both the mentors and mentees are doing.

All of the above is upheld to keep the behind the scenes of the program functioning efficiently so the mentoring service can be delivered effectively. The leadership team also meets weekly to stay up to date with all of the information and resources being requested by the mentors for their mentees. Preparation for the weekly team meeting takes place by gathering any updates that the mentors need to be made aware of and sharing what events will be occurring that week. The leadership team works on any program-specific tasks, including mentor-mentee pairings, discussing the Qualtrics forms, and checking all tracking avenues. Canvas, GroupMe, and outlook email are used to promote events, send out reminders, calendar invitations, and maintain communication with mentees during the semester.

This year, a new program iteration includes the program manager meeting one-on-one with the mentees, at least once a semester and as often as they like. The program manager takes this opportunity to answer any questions the mentees may have, providing further guidance and support. This provides mentees with a deeper connection with the program and leadership team. The idea is to build trust and reassure the mentees that they have a support system and a community through the peer mentoring program. It is also through these meetings: mentor/mentee, leadership

team/mentors, program director and manager/mentees, that their needs and concerns can be heard directly from them.

The program from the beginning was designed to be dynamic, the student coordinator and graduate student not only help with managerial tasks but also help connect the mentors and mentees with the rest of the leadership team. Suggestions are also presented from mentors, student coordinators, and graduate assistants based on the personal experiences of when they first entered the university. Sharing that information with the program director and manager, help in advocating for students who are in positions they were in the past.

Limitations

The findings listed do not include the full cohort for 2025-2026 as the data for these students is not finalized. This program also accepts first-year students with a spring entry, final numbers for this year in regard to mentees participating and retention will not be able to be calculated until the academic year has concluded.

Results

In Fall 2025, there were 200 first-year students originally enrolled in the school of engineering. Of those there were 94 identified as possible mentees based on available university data and 61 first-year students (approximately 64.9%) joined and actively participated throughout the semester keeping up with the requirements of the program. Table 1 presents demographic data for the Fall 2025 cohort participants, including if they identify as first-generation and Pell-eligible.

Table 1. First year Engineering Students: 2025 Cohort (N=200).

	Total First-Year Cohort (N=200)		**Total Program First-Year Cohort (N=61)**	
Variable	N	Percent	N	Percent
Gender				
Female	75	37.5%	29	47.5%
Male	125	62.5%	32	52.5%
Race/Ethnicity				
Asian	16	8.0%	4	6.6%
Black or African American	21	10.5%	17	27.9%
Hispanic of Any Race	66	33.0%	33	54.1%
Nonresident/International Student of any Race	8	4.0%	0	0.0%

Two or More Races	14	7.0%	3	4.9%
White	66	33.0%	4	6.6%
Not disclosed/Unknown	8	4.0%	0	0.0%
Native Hawaiian/Other Pacific Islander	1	0.5%	0	0.0%
Pell-Eligible	73	36.5%	43	70.5%
First-Generation	49	24.5%	28	45.9%

Student Engagement

Due to the tracking operational systems used by the program student engagement is evident in the data collected for Fall 2025. There were a total of 305 mentor and mentee meetings, each meeting averaging about 1.033 hours. A total of 15 weekly seminars and events took place throughout the semester; the average duration was 1.46 hours. The average total attendance per seminar or event was 35.2 people and 20.9 mentees per event.

Student retention

Table 2 shows retention percentages by year starting in 2021 when the program was established. The 2021 cohort is the first to complete the program and reach graduation. The total retention for those students is 83.8% compared to school of engineering retention rate at 46%. The 2024 cohort has a retention rate of 94.2% compared to the engineering school rate of 78%.

In Fall 2024 to Spring 2025 there was 100% retention among program participants, compared to 95.7% among students who did not participate in the program. Although the current cohort's data is not yet finalized, the previous year's data set suggests improvement in retention outcomes and supports the relationship between program engagement and student success.

Table 2. Program Retention Compared to the School of Engineering Retention Rate

Cohort	First-Year Students (N)		1st Year		2nd Year		3rd Year		4th Year	
	Program	School	Program	School	Program	School	Program	School	Program	School
2024	52	170	94.2%	78%						
2023	63	226	95.2%	74%	95.2%	66%				
2022	35	234	91.4%	76%	85.7%	70%	86.7%	68%		
2021	37	207	94.6%	67%	91.9%	60%	89.2%	57%	83.8%	46%

Service Blueprint Program Application

The three layers of the service blueprint were applied to the program, and a visual map was created that contained touchpoints, pain points, and interactions among stakeholders. Using insights from the students who were a part of the program for years, areas of tension and possible areas of improvement were identified. The service blueprint for this peer mentoring program was a collaborative effort by students' part of the leadership team and has now been updated with this year's iteration. The graduate assistant was a peer mentor for two years and a graduate assistant for two years. The student coordinator started as a mentee, then a mentor, and was invited to join the leadership team as a student coordinator for two years.

Applying this to the peer mentoring program: (1) the *frontstage*, is described at the mentee experience; (2) the *backstage*, refers to the mentor training, data collection methods, program dynamics, and interactions between everyone; and (3) the *infrastructure*, consists of the many tools used by the program including trackers, communication tools, survey platforms, cloud-based content management and storage. Mapping out the program framework allows for touchpoints, strengths, and pain points to be identified and solutions and improvements to be determined.

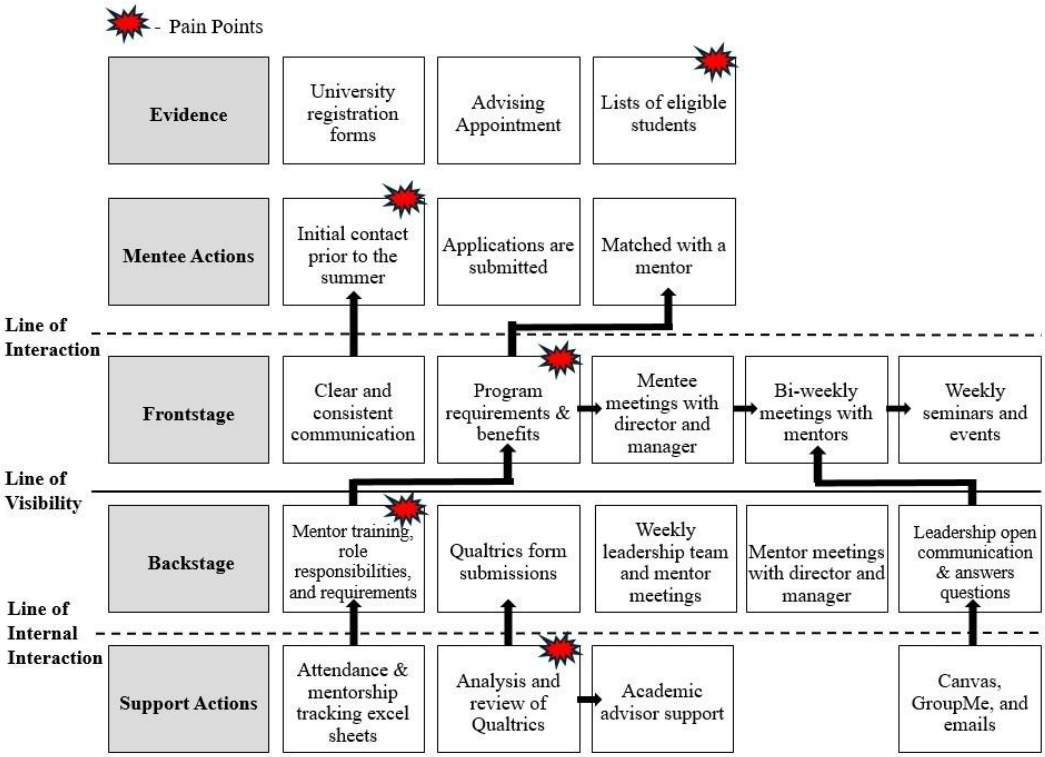

Figure 1: Service Blueprint Peer Mentor Program Framework

Discussion

Personal Reflection: Graduate Assistant (GA)

Over the course of three years with the program, I was present for the program's pilot year and was within the first group of mentors for the program. I had the incredible opportunity to be a mentor for two years and now I am working as the graduate assistant with the leadership team. As a mentor, I aimed to create a supportive environment with my mentees, where they could share their problems, questions, and personal experiences during their first year. I wanted my mentees to be able to share their academic and personal challenges as well as their triumphs and successes. I made a conscious effort to check in with my mentees, not just academically and professionally, but socially to fully understand their experience. The bi-weekly or weekly meetings, depending on the mentee's preferences, provided valuable insight into their daily life. I was there to support them and ensure they had someone they could talk to and ask questions; I could offer mentorship and guidance based on my own experiences. If I didn't know the answer, I could pass their questions along to the leadership team who had more insight and connections around campus. The other mentors were also very helpful in providing suggestions and answers when discussing our mentee's challenges with one another.

I too was a first year in college once, there were many questions I had, and I didn't know who to ask. I didn't know what I should be doing outside of the academic portion of college. I wanted to build a relationship with trust, so that my mentees knew they could come to me, we could celebrate together, and plan for the future; I wanted them to know they were not alone. During that pilot year for the program, we created the foundation and continued to build upon it. As a team we discussed seminars and events we thought would be helpful for mentees, drawing from our own experiences. It was through these meetings that we began developing the program and determining what was working and what was not. We also made efforts to keep track of what should be improved for the following year and the new cohort of mentees.

As I transitioned into the role of graduate assistant, I gained a deeper understanding of the program's infrastructure and got to see how the program evolved throughout the years through the feedback of the leadership team, mentors, and mentees. It is a privilege to contribute to a program that touches so many people's lives, helping them continue their path and journey in the fields of engineering and computer science.

Emerging Strengths

The program's dynamic operational framework is illustrated through its service blueprint, which is grounded in clearly defined requirements to ensure sustained engagement. This was done from the beginning, through consistent and thorough communication, mentor matching, bi-weekly

meetings with assigned mentors, weekly seminars (with a minimum attendance requirement of two per month), and structured a leadership team, program assistant, advisor, mentor, and mentee touchpoints. Collectively, these components function as an integrated system.

This program was designed and implemented with the intent to help students during their first year of university by providing them social, academic, and professional support. The goal is to bridge gap in support, foster perseverance, and ultimately improve retention and engagement. The touchpoints embedded within the program encourage adaptation to better serve student needs. Frequent and open communication ensures the mentees and mentors' needs and opinions are acknowledged and incorporated.

Identified Pain Points and Implemented Solutions

The areas for concern and pain points identified using the service blueprint consisted of reaching out and establishing contact with possible mentees. This program relies on the queries, lists, and spreadsheets pulled by the university to inform possible mentees about the program. However, since incoming students are at times undecided, switch majors, put the wrong contact information or mistype their contact information, initial contact may not be received. Students suggested sending out information and invitations to the program via mail to both the students and their parents.

The remaining three pain points involve the stakeholders: mentees, mentors, and leadership team doing their part to keep the program going. Mentees are required to meet one-on-one with the program director and manager, meet with their assigned mentor at least bi-weekly, and attend two seminars a month. Mentors are to receive training and learn about their responsibilities, meeting with their mentees at least bi-weekly, attend weekly meetings with the leadership team, meet one-on-one with the program director and manager, and maintain communication through the other systems used (tracker, emails, canvas, & GroupMe). The leadership team ensures the events, seminars, and meetings take place weekly, upkeep the Qualtrics forms and offer support, ensure the mentee/mentor meetings take place, check the trackers, offer resources and support, and maintain open communication with the entire program.

All of these pieces together ensure the program runs, each must do their part. One of the main difficulties faced are the reporting and tracking systems, as there are several platforms used. These were condensed over the years and developed by the leadership team, the student coordinator and graduate assistant do upkeep. If another tool can be found that can consolidate the systems needed even more, it would aid in streamlining the process. Up to this point, all files are kept in the Canvas course module and in Box, a web-based platform used to store and manage content.

Students are required to attend two seminars of their choice each month; however, this excludes students unable to attend due to class conflicts. Prior to creating the program's semester calendar, mentees schedules are reviewed and the best times are chosen for the majority of students. For select seminars, two identical sessions are offered within the same week on alternate days, providing students with the opportunity to attend. This approach is one of the several ways the program is intentionally designed to promote engagement and participation. Mentors and program assistants are encouraged to attend the seminars and events to interact with mentees beyond their assigned groups. By mingling during events, mentors, program assistants, student coordinators, and graduate assistants aid in creating a greater sense of community. This allows students to make friends and connect with peers in similar circumstances who can offer guidance and further support. Mentors have access to seminar topics and resources; they can go over seminar information.

Conclusion

Using the service blueprint provided an in-depth view of the program's framework and operational systems. The blueprint was developed using the insights of student leaders who have been involved in the program over several years, providing a comprehensive and experience-based perspective. One of the program's most distinctive features is the structured engagement that allows for student involvement. A new iteration of the program in 2024 allowed mentees to transition into program assistant roles, where previously only upperclassmen could return to the program as mentors. This serves as a steppingstone to students who are interested in becoming a mentor, enabling students to gain experience, develop leadership skills, and gain insight into program operations.

Another defining characteristic of the program is its flexibility and its design to remain dynamic. Although other peer mentoring programs share similar touchpoints and communication networks, this program evolves yearly to better serve student needs. Growth occurs not only in numbers, but also in the resources and support offered to mentees. Program change and yearly design is guided by direct input from mentees, mentors, program assistants, and student leadership. Continuous meetings, discussions, surveys, and suggestions are actively reviewed and implemented when feasible. It is important to note the significance of also maintaining the foundational structure that ensures consistent engagement and program quality.

The program's responsiveness and adaptability shape the impact on mentees and provides a model that may facilitate the design and implementation of similar peer mentoring initiatives at other schools of engineering. The results are intended to offer guidance, best practices, and lessons learned, shown through the program structure and impact; which are supported by the service blueprint to those in similar situations or seeking to learn more. There are students who remain involved while still attending university and those who still return after graduation to attend events forming a supportive community.

Weekly meetings and personal one-on-one meetings with the leadership team further strengthen the program by opening the door to advocacy, problem solving, and direct communication between students, faculty, and staff. For example, seminar topics are intentionally selected based on mentee feedback, mentor personal experiences and suggestions, survey submissions, and student leadership insight. These could be seen by topics that range from stress management, financial literacy, professional development, and imposter syndrome to holding a gingerbread competition and potlucks. They reflect challenges often faced by first year students and showcase the program's commitment to supporting students socially, academically, and professionally.

Ultimately, this peer mentoring program is designed through the help of engineering students for engineering students, supported by a program director and manager with incredible experience and knowledge in education. By listening to students and allowing a collaborative environment, the program remains dynamic and constantly evolving for the better. This student-centered approach combined with structured engagement through mentorship is what distinguishes the program and

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