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Work in Progress: Using Participatory Design and Qualitative Research Strategies in the Development of a New Faculty Mentoring Program for Undergraduate Engineering Students

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WIP: Using participatory design and qualitative research strategies in the development of a new faculty mentoring program for undergraduate engineering students

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Abstract

This is a work in progress. It is common for higher education institutions to implement mentoring programs for their undergraduate students to aid in their transition to college. This transition may involve things like starting an in-residence education away from home, building a professional identity, the attainment of new academic goals and growing a professional network. These could be critical aspects for first-generation students, and overall, in STEM-related careers, where minorities are usually underrepresented. However, there are still important challenges related to the implementation and creation of institutional mentoring programs for undergraduate students in engineering. One roadblock is the potential lack of participation of faculty and students in formally implemented programs. This paper proposes a methodology for the early involvement of faculty, students, and academic advisors by showcasing their experience in the redesign of the undergraduate mentoring program in an R1 university in the US. We are using a participatory design approach to get staff and students involved early and become partners in the construction and delivery of a renewed mentoring initiative. In the first stage, we are collecting evidence using open-ended interviews and participatory design workshops with faculty, students, and staff to understand the local culture around mentoring, perceptions about mentoring, and barriers to success. We are analyzing this data using Grounded Theory. Our preliminary findings help us to have an understanding of how mentoring takes place contextually in our institution and how it relates to existing theoretical frameworks. In addition, our participatory methods may help other institutions in seeing students, faculty, and academic advisors as partners, and in deploying participatory methods to create engaging programs in different areas of academic life.

Keywords: participatory design, intervention, mentoring, engagement, undergraduate engineering education

Introduction and Theoretical Framework

In STEM careers like engineering, many groups, such as first-generation students, ethnic minorities, low-income students, and women often have inadequate representation [1], [2], [3]. Factors impacting this are complex. At the high school level, minoritized and low-income students are more likely to apply to a constrained set of college choices compared to where their capabilities suggest they might gain admittance, less likely to enroll in a four-year institution after the admissions process, and more likely to face barriers to entry due to a lack of equitable access to guidance and information about how to negotiate the application and enrollment process [4]. At the college level, this issue is often further explained by high college dropout rates and lack of enrollment in STEM majors, but the absence of parental participation in university education and underlining educational disadvantages could also play a role [5]. Overall, persistence for underrepresented groups in the field varies and differs widely by institution [6]. For myriad reasons, the transition to and through college can be a challenging one for all students, and it is increasingly common for higher education institutions to implement support programs [7], [8].

Mentoring programs have shown promise for enhancing student success and can be key to social justice [9]. Sometimes used as synonyms, formal mentoring and advising for undergraduates entails setting up a relationship between a more experienced individual and a less experienced "protégé" [9], [10]. Mentoring has been used across disciplines to support the development of new members in a field, and having a strong mentoring relationship has

been linked to greater success and persistence in that domain [11], [12], [13]. In STEM fields in particular, mentoring has shown promise as a method for increasing persistence rates [14], [15]. Given the link between mentoring and program persistence, it is common for higher education institutions in the US to implement mandatory mentoring programs for their undergraduates in their transition to college. These programs are intended to help students to construct a professional identity [16], [17], grow a professional network [18], [19], and work toward the accomplishment of goals in their newly acquired academic life.

However, there are still important challenges related to the implementation and creation of mentoring programs for undergraduate students in engineering. These include elements such as the quality of mentors [20], the ability to establish trusting relationships between minority students and mentors across lines of difference [21], the limited available time for mentoring activities [19], and engagement beyond departmental sanctions [22]. Literature shows a lack of involvement of students and faculty in curricular or planning decisions [23] that could lead to disengaged participants [24]. In addition to the challenges of non-involvement, few programs look to improve the performance of faculty mentors or cultivate a mentoring community [25]. Research suggests that effective involvement in such decisions could create a sense of community and perceptions of shared responsibility [26]. To reap the benefits that mentoring programs can provide, it is critical for universities to develop systems that overcome these engagement challenges and pave the way for the healthy development of strong mentoring relationships between students (protégés) and faculty (mentors).

The following article reports on a context-sensitive qualitative research study that looks to expand the research on mentoring in undergraduate engineering education and improve its use in a specific university setting. With an eye toward increasing the participation of those directly involved in the mentoring community, this participatory-design study uses techniques that can foster the involvement and engagement of faculty, students, and staff. Being a work in progress, the preliminary findings aim to shed light on the use of participatory techniques to enhance the construction of a new mentoring undergraduate experience.

Mentoring undergraduate students in engineering

Mentoring has been defined in myriad ways, and there exists no single widely accepted definition of mentoring [9], [27], [28]. Nonetheless, a common element amongst definitions is that mentoring involves the guidance of the mentee toward their goals [29], [20]. Zellers and colleagues [30] put forth a useful definition of mentoring as a "reciprocal learning relationship characterized by trust, respect, and commitment, in which a mentor supports the professional and personal development of another by sharing his or her life experiences, influence, and expertise" [p. 555]. For us, this definition highlights the depth and complexity of successful mentoring. After a close review of the literature, we opted for sticking to [31]'s identification of 4 latent variables that were validated by [32] in 2009 for the College Student Mentoring Scale. The variables underlying the mentor-protégé relationship at the collegiate level involve (a) Psychological and Emotional support, (b) Degree and Career Support, (c) Academic Subject Knowledge Support, and (d) the Existence of a Role Model. While more testing is needed to validate these constructs in a variety of settings, it provides an important starting point for a contextually sensitive mentoring study. A definition with this level of theoretical specificity can be helpful for assessing program success. To that end, we seek to understand if these constructs are present in our own institution in order to design interventions for improvement.

Participatory design methods to achieve engagement

When research is conducted for the purpose of building knowledge to improve action, an important aspect of effective design involves including those for whom that knowledge will have an impact. Participatory research design methods can do that [33], [34], [35], [36], [37]. Participatory research design methods emphasize involving local actors in all stages of the process, to account for their priorities, perspectives, and preferences [38]. An umbrella term that encompasses a variety of disciplines and frameworks [39], participatory methods emerged from concerns about research being done *to* people rather than *with* them and a philosophy that engaging and partnering

with those who are expected to use and benefit from the research will lead to more inclusive and equitable outcomes [40], [41]. An underlying assumption of participatory research is that it is built on a core foundation of trust and mutual respect between researchers and participants [40]. Inherent in the design methodology of participatory research, as well, is an understanding that it is conducted with the explicit purpose of taking action or enacting change to improve an outcome of importance to those involved [39]. While participatory research methods do not exist without criticism, when done well they can lead to more effective results [38].

In the engineering mentoring context, the current gap in participation and engagement can be bridged using participatory methods. [42] posit that for improvement to happen, work must be (among other elements) problem-specific and user-centered. In other words, improvement research must be developed in a participatory way. This first phase of our research focuses on hearing the perspectives of our users to ensure that we can see the system at play and design improvements that are specific to the problems they are facing. Future phases will center on piloting and scaling improvements to ensure that they are user-centered, account for variability, and can be measured to evaluate effectiveness [42]. By employing participatory design methods in our study, we are aiming to uncover the perspectives and priorities of those who interface with undergraduate mentoring most directly – students and faculty. Doing so will engage and involve those individuals as partners in both the construction and delivery of the mentoring initiative to ultimately lead to a more successful outcome for students.

Research Context

Johns Hopkins University is the 6th most ethnically diverse National University according to US News and World Report for 2022-2023 [43]. In Fall 2022, 38.9% of Johns Hopkins' first-year undergraduate students belonged to an underrepresented group, and 30.8% of incoming first-year undergraduates were identified as first-generation and/or were Pell-eligible according to the U.S. Department of Education [44]. Apart from achieving more diversity in the student body, the institution has followed an exhaustive curricular revision for the Schools of Engineering, Arts, and Sciences, and Medicine by the "Second Commission of Undergraduate Education" [45]. In addition, the Excellence in Academic Advising (EAA) process caused our engineering school to review all aspects of our advising and mentoring process. In line with literature, mentoring roles differ between teaching, advising, and mentoring [22]. We've been prompted to re-envision our model to one in which professional advisors assist students at the time of registration, while faculty adopt a mentorship role. With all this changing context, the school is working on a revamped undergraduate mentoring program that is expected to deploy in 2024. The school has a freshmen cohort of 450 students, we are hiring new advising staff, and our existing faculty is re-envisioning their roles as mentors. It is in this process of reformulation of the program that we used goal-directed and people-centered design techniques coming from User Experience Design (UX) and Interaction Design (IxD) [33], [34], [35], [36], [37] with the aim of looking to develop a program that resonates with educators and where students become partners in the process [26], [46].

Methods

The Johns Hopkins University's Whiting School of Engineering is our main unit of analysis. The research questions we aim to tackle are:

- **RQ1**: How is mentoring conducted and understood today in our institution? How is it perceived by faculty and students? Are they coherent with the four variables underlying the mentor-protégé relationship?
- **RQ2:** What are the key touchpoints in a student's experience journey regarding mentoring? What might be some critical touchpoints to consider in the design of a new or revised system?

Participants

To recruit student, staff, and faculty participants, we are using a combination of an "open call" and snowball

sampling techniques [47]. Once we got our first responses for volunteers, we began emailing each department to balance the representation of participants across gender, departments, and tenure and non-tenure tracks. In the recruitment of students, a call blurb was posted multiple times in the student announcements email that is sent monthly by the advising office. Every part of the recruitment process followed the IRB's Student Recruitment guidelines. Additionally, we asked the advising office to set up a group of staff members to conduct at least two workshops. This was also a voluntary participation request.

A few months into our research, we have conducted thirteen interviews with faculty and students from different departments, genders, and age groups. To date, seven faculty interviews and six student interviews have been conducted. The faculty members interviewed come from five distinct departments within the broader engineering school. Additionally, they encompass both non tenure track and tenure-track faculty, both novice and veteran faculty, and both male and female faculty (there have been no participants identifying as non-binary). As a result, the preliminary interviews represent a broad range of perspectives and experiences within the school. Additional recruitment efforts will center on ensuring that faculty and students from all departments across the school are represented in the sample. Table 1 summarizes the initial interview sample. We are expecting to conduct at least 20 interviews in total before deploying the first small-scale pilot of our program. Interviews have been transcribed into a word processor and we have three coders looking for salient themes. In addition, we have conducted two workshops.

Total of participants to date	**13**
Departments represented	5
Tenure-track faculty	2
Teaching-track faculty	5
Students	6
Males	4
Females	9

Table 1. Initial interview sample.

Data Collection and Analysis:

Participatory design methods call for researchers to first understand the context within which they are seeking to develop improvements and utilize that context to engineer improved solutions [42]. This is what we aim to do with the first phase of our study. To examine these research questions in a participatory way, we are implementing a qualitative design, where we are conducting 45-minute to 1-hour long qualitative semi-structured interviews [48], [49], [50] with faculty, students, and staff. We informed our research protocols on the literature deriving from mentoring in higher education published by AERA and ASHE [9], [51]. The IRB submission consisted of one protocol for interviewing students, and a protocol to carry out open-ended interviews with faculty and staff. We are offering to conduct these interviews either in person or in Zoom. Data collected from the interviews is being transcribed using a word processor and anonymized before analysis. Given our focus both on understanding mentoring perceptions and on seeking to uncover which elements of mentoring are currently present in the institution, our interview protocols center on asking about these concepts. For example, participants are asked to share their personal definition of mentoring and their beliefs about what constitutes effective mentoring. Then, questions center on examples and experiences.

In addition, we conducted two workshops with the same goals. As shown in Figure 1, one of the workshops aimed to understand the context, as perceived by the staff, for mentoring today. This process involved the use of sticky notes and markers to discuss the student's mentoring journey and its touchpoints. We then transformed this raw data into a visual journey using graphic design software. The output was then returned to the advisors for confirmation. From that workshop, we gathered fieldnotes from the experience.

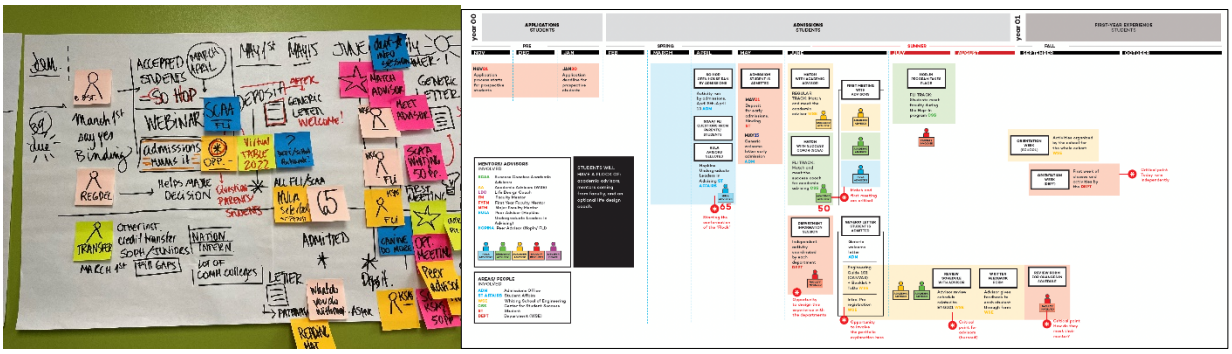

Figure 1. Student journey achieved in a participative workshop with 5 advisors at the institution.

To achieve internal validity [52], we are using data triangulation [53], [54] by contrasting information from different sources (staff, faculty, and students), and qualitative data coming from the workshops. All the data coming from field notes, oral interviews, and workshops are being transcribed and analyzed using Grounded Theory [55]. Salient themes are then discussed and negotiated amongst the research team in order to create a list of codes that can help to describe the cultural context of how mentoring works at our institution. This process is still in progress.

Preliminary results

In interviews, faculty and students have been open and eager to discuss their experiences with undergraduate mentoring at the school. Preliminary findings from the interviews have shown some incipient trends. One common thread among faculty interviewees is the importance of getting to know the student and their goals as a vehicle for building relationships and individualizing the mentoring experience. However, while there are some similarities in how faculty members approach the task of mentoring, interviews reveal that each faculty member has developed their own mentoring systems and best practices based solely on their personal learnings and expertise rather than on a common set of best practices across the university. The four latent factors of mentoring seem to be present; nonetheless, they seem to be related to the experience of the faculty (if they have been in the industry, their major, research, etc.), and how many years the student has before graduating. In addition, there exists a stark contrast between teaching-track faculty, who are assigned to advise up to 25 first-year students from all areas of interest, and tenure-track faculty, who are assigned a smaller group of students that are related to a major in their department. This results in the discontinuity of mentoring experiences for faculty members and students alike. Furthermore, interviews with students and faculty reveal that time constraints and competing work priorities impede the quality of relationships. The workshops revealed an overwhelming enthusiasm from the staff to be heard by management on topics related to the student's educational journey. During the participatory workshop, staff felt that they could voice concerns and ideas of how to improve the existing system.

Preliminary conclusions

This work in progress shows there is an opportunity to use participatory design methods to improve the multivocality of the design of a mentoring experience in an engineering school. There has been acceptance and even interest in participating, overall, from the students and teaching faculty. Interviews with faculty and the workshop with advisors might have served as a reflective practice, in line with what [56] showcased in their study on

collaborative course reflection. We believe that this participative process might be the first step toward building a reflective practice that could lead to more effective teaching and mentoring. From a research point of view, we are working on carrying out more interviews, transcribing, and coding them to get a better sense of what the revised mentoring process should encompass.

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