An Exploratory Study on Post-Secondary STEM Mentorship within Student Organizations

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***Abstract*—In this qualitative research paper, post-secondary student views of science, technology, engineering, and mathematics (STEM) mentorship within student organizations are investigated towards illustrating what mentorship looks like within this context. Effective mentorship is crucial for shaping the future STEM workforce as it can enhance diversity and inclusion, which foster innovation and creativity. This exploratory study focuses on the intersection between mentorship during post-secondary education, which is often overlooked compared to youth and professional mentorship, and student organizations, which are likewise understudied. The overarching study aims to reveal what types of student organizations incorporate mentorship, the activities that support it, and its effectiveness in fostering positive STEM outcomes, as well as the kinds of mentoring relationships that are forming in these spaces. Data was collected through one-on-one interviews with students from various student organizations at a large, public, predominantly white institution (PWI) with very high research activity in the Southeastern United States. This data was catalogued, quantified, and visualized to reveal the current landscape of STEM mentoring within post-secondary student organizations. These findings aim to enhance understanding of STEM mentorship in the context of student organizations while laying the groundwork for further research on the role of mentorship in STEM education.**

***Index Terms*—mentoring, STEM, student perception, underrepresented students**

I. Introduction

The effective mentorship of STEM students is a topic of national importance due to its role in shaping the future STEM workforce [1]. Individuals from historically marginalized communities (HMC) [2] experience systemic barriers that often result in lower college completion rates and thus limited career options [3]. Increasing the number of HMC students that enter the STEM workforce can serve to increase diversity and inclusion, which can, in turn, increase innovation and creativity [1]. While mentorship is recognized as a crucial component of a STEM student's professional formation, most of the literature on the topic focuses on youth mentorship, which occurs during the mentee's primary and secondary years, or professional mentorship, which occurs once the mentee has entered the workforce [1]. This leaves mentorship that occurs during the mentee's post-secondary education comparatively underrepresented in the literature.

There are many different types of student organizations at post-secondary institutions, but all are extracurricular and student-operated, with the baseline requirement that one must be a student in order to become a member [4]. Studies on participation in student organizations have shown them to improve student satisfaction with the collegiate experience, increase on-campus involvement, and promote student development [5], especially for HMC students [4]. There is academic merit, therefore, to illustrating what mentorship looks like within the context of student organizations as they are part of the collegiate environment and "students, themselves, are social and cultural constructions that emerge from and are shaped by the environments they inhabit" [6]. The studies that have examined post-secondary STEM mentorship, however, have largely failed to explore mentorship that occurs within the context of student organizations. A recent scoping review found that only 20 publications discussed mentorship within this context [7]. This study therefore focuses exclusively on student organizations that claim to provide mentorship opportunities for their members.

II. Motivation and Research Questions

This continuing, exploratory study has four stages. In Stage 1, a scoping literature review on the intersection of mentorship and student organizations was conducted [7], and three focus group interviews were held with members of student organizations (unpublished). These two processes were meant to reveal the landscape of mentorship in student organizations from the perspective of both the literature and current student organization members. These processes also aided the research team in the development of a thematic codebook on three mentorship categories: traditional, effective, and critical [7].

One of the more interesting recurring topics that came up during the focus group interviews was that while many students were able to describe their mentorship experiences within their student organizations with great detail, few were aware of – or, if aware, failed to articulate – the formalization and/or infrastructure that existed to support these experiences. *Formal mentorship*, as defined here, refers to mentoring relationships wherein the mentor and mentee are assigned to one

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another [1]. This definition may also include guidelines for engaging in the mentoring relationship or responsibilities for one or both parties.

In light of that finding, Stage 2 explores the landscape of mentorship in student organizations from the perspective of the executive board members of student organization at the campus level. Stage 3 will explore the landscape of mentorship in student organizations at the national level by investigating professional organizations with student chapters. Stage 4 will synthesize the findings from stages 1 through 3 to produce a culminating overview of the systems that exist for mentoring within student organizations and provide a conceptual mentorship framework.

The study described in this paper is part of Stage 2 and was conducted to further explore mentorship in student organizations by interviewing the executive board members of student organizations that claim to provide mentorship opportunities for their members. While six aims are presented for the full research project, this study focuses on aim one. The overarching aims of the larger study are to reveal the following:

1) What types of student organizations have built mentorship into their structures and why have they chosen to do so?
2) What kinds of student organization activities support mentoring and how are these activities supportive of mentorship?
3) How effective are these mentorship activities in fostering positive student outcomes in STEM?
4) What kinds of mentorship relationships are represented in these spaces?
5) How do the markers of effective mentorship relationships found in the study compare with those found in the literature?
6) What traits are most desirable for mentors and mentees within the context of student organizations?

III. Methodology

A. Study Description

One-on-one interviews were utilized for preliminary data collection. The study site was the main campus of a large, public, predominantly white institution (PWI) with very high research activity located in the Southeastern United States. The sample for this study included all students currently attending the aforementioned university that were involved with registered student organizations in some way during the sampling period. *Registered student organizations* are defined as voluntary groups of students joined together by a common interest, cause, or mission that have registered with the university. Registration grants student organizations certain benefits, such as access to campus facilities and university resources. One benefit of registration is that student organization information is listed on a university-maintained database accessible to those with active university credentials.

For the purposes of this study, the types of student organizations examined will be defined as follows: *professional student organizations* are those which are affiliated with a larger professional organization for the promotion of a field, discipline, or profession; *fraternities and sororities* are social organizations with varying goals sometimes referred to as *Greek life*; *interest student organizations* are dedicated to reaching a shared goal; and *identity-based affinity student organizations* are typically based around historically marginalized communities, but can be based on any common identity, such as gender, race, sexuality, language, or country of origin. This information is summarized in Table 1.

TABLE I
Definitions and Examples of the Types of Student Organizations Explored in this Study

Type	Shorthand	Example(s)
Professional student organizations	Professional	Institute of Electrical and Electronics Engineers (IEEE)
Fraternities and sororities	Greek Life	Sigma Kappa Sorority (SK)
Interest student organizations	Interest	Engineering design teams
Identity-based affinity student organizations	Identity/ Affinity	Out in Science, Technology, Engineering, and Mathematics (oSTEM); Society of Hispanic Professional Engineers (SHPE)

Some student organizations may belong to multiple types. For example, some professional student organizations are also identity-based affinity student organizations. The Out in Science, Technology, Engineering, and Mathematics (oSTEM) student organization is both a professional student organization, since it is affiliated with the oSTEM professional society, and an identity-based affinity student organization serving the LGBTQ+ STEM community [8]. Another example is the Society of Hispanic Professional Engineers (SHPE) student organization, which is both a professional student organization, since it is affiliated with the international engineering society SHPE, and an identity-based affinity student organization, since its goal is to promote the advancement of Hispanic STEM professionals [9]. Identity-based affinity student organizations are of particular interest for the research team due to the positionality of the researcher.

The types of student organizations discussed earlier in this section are not exhaustive, as there are several other types of student organizations that exist on campus but will not be explored in this study, such as *sports and recreation student organizations* and *student government political parties*. Sports and recreation student organizations were excluded from this study as they have not been shown to affect student's academic performance [4]. Student government political parties, on the other hand, were excluded as they have the potential to exert some influence over institutional policies, such as the amount of funding that goes towards other student organizations, setting them apart from other types of student organizations.

According to the student organization database, there were 1,084 active registered student organizations at this university at the time of writing. 59 organizations were identified as sports and recreation student organizations and six were identified as student government political parties; after removal,

963 student organizations remained for possible inclusion in the study.

B. Data Collection Methods

Data was collected to answer the question, "What types of student organizations have built mentorship into their structures and why have they chosen to do so?"

One-on-one interviews were organized during the 2024 Spring semester. A list of student organizations that claim to provide mentorship for their members was compiled by searching the student organization database for the keyword "mentor". Contact information for the executive board members of these organizations was collected from the database after this search was performed. An additional organization contact list was provided by the College of Engineering. 182 potential participants from both sources were invited to schedule interviews with the researcher via email and encouraged to forward the email to others who may also be interested in participating. All interviews were scheduled based on participant availability.

Twenty-four participants volunteered to be interviewed for this study, resulting in a response rate of 13.2%. Interviews were conducted virtually via the video conferencing platform Zoom by the researcher. Each interview lasted between 10 to 15 minutes. Interview data was collected in the form of transcripts using Zoom's built-in live transcription service and saved as text files. Verbal consent was obtained from each participant before the interview protocol started. Interviews were semi-structured to allow for a natural flow of conversation and were guided by the following questions:

1) Do you have a formalized mentorship program? Could you tell me more about it?
   a) Is this program mentioned on your website?
   b) Is this program mentioned in your constitution?
2) What are the components or activities of the program?
3) What are the requirements for being a mentor/mentee?
4) Does your organization have a mentorship officer(s)?
5) Does your organization collect any documentation of mentorship?

The primary form of data collection was via one-on-one interviews, as described earlier, however, the student organization website and/or constitution was examined if participants responded "yes" to questions 1.a and/or 1.b, respectively. This examination step was done just in case there was additional information on mentorship in either location that the students did not articulate directly when interviewed.

C. Data Analysis Methods

All interview data were collected via Zoom transcript, which are saved as text files. Data for questions 1, 2, and 3 were summarized and results presented in narrative format. All other data were quantified via keyword search and visualized using Microsoft Excel. Mentions of mentorship on student organization websites and constitutions, the inclusion of a mentorship officer, and the collection of mentorship documentation were used as ways to explore the level of formalization of mentorship within a given student organization, with the presence of these components suggesting higher levels of formalization within the organization.

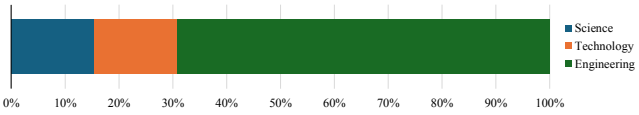

Fig. 1. STEM Fields Represented in this Study

TABLE II
STEM FIELDS REPRESENTED IN THIS STUDY COMPARED TO THOSE IN THE SCOPING REVIEW [7]

STEM Field	Study Data (n = 26)		Scoping Review (n = 11)	
	n	*%*	*n*	*%*
Science	4	15%	8	73%
Technology	4	15%	1	9%
Engineering	18	70%	2	18%
Mathematics	0	0%	0	0%
Total	26	100%	11	100%

IV. RESULTS AND DISCUSSION

The 24 participants in this study represented 19 different STEM student organizations. Four organizations were representative of science (15%), four were representative of technology (15%), and eighteen were representative of engineering (70%). Note that these numbers add up to 26 rather than 19 as individual student organizations can represent more than one STEM field. Unfortunately, no mathematics student organizations were represented in this study. Figure 1 summarizes these results.

The lack of representation for the field of mathematics agrees with the findings of the scoping review [7], as there were also no mathematics student organizations represented in the included articles. The over-representation of engineering and the relatively low representation of science and technology, however, are at odds with the scoping review results [7]. For the purpose of comparison, data from Table 6 of the scoping review [7] has been included in Table 2.

Regarding student organization types, professional student organizations were the predominant group represented, with 13 organizations classified in that category. Of these 13 professional organizations, five were also identity-based affinity student organizations. The other six were interest-based student organizations, five of which were engineering design teams. There were no fraternities or sororities represented in this dataset. This is summarized in Table 3.

All student organizations explored in this study incorporated some form of a formalized mentorship program into their structures. Most of the organizations had a single mentorship program that paired freshman and transfer student mentees with upperclassmen or graduate student mentors. This is known as peer mentorship, which is defined as "mentoring relationships formed between individuals who are at approximately the same stage of career development" [1]. Participants

TABLE III
TYPES OF STUDENT ORGANIZATIONS REPRESENTED IN THIS STUDY

Type	*n*	%
Professional	13	68%
Greek Life	0	0%
Interest	6	32%
Identity/Affinity*	5	26%

*Identity/Affinity was a subset of Professional for this dataset.

expressed a desire to give back and build community as primary motivators to incorporating mentorship into their organizations. Several participants also noted that mentoring experiences provided them with resources, internships, and networking opportunities, that they would not have previously had access to. Many, particularly those on design teams, emphasized the importance of less experienced students working under more experienced students in an apprentice-like fashion, describing how incoming freshman who come into their organizations can develop their skills and learn how to teach others to do the same. The apprenticeship model described here is known to improve the professional practice of engineering students [10] and seems appropriate for engineering design teams.

Additionally, there were three organizations that utilized industry partnerships to provide mentoring opportunities wherein a working STEM professional would mentor a university student. In these instances, the student organization would collect mentee applications from interested members and share them with the industry contact; this individual would then pair student mentees with industry mentors. This hands-off approach made it so that participants from these organizations did not have much to say beyond a cursory overview of the program.

The level of formalization of mentorship within student organizations was inferred through the presence of four components: mentions of mentorship on the organization's website, mentions of mentorship in the organization's constitution, the inclusion of a mentorship officer, and the collection of mentorship documentation. The reasoning behind this measure was that including these components suggests mentorship is important to the organization and there is reason to believe that there is infrastructure supportive of that mentorship. 53% of all the student organizations represented in this study had some mention of mentorship on their website, while only 37% mentioned mentorship in their constitution. Interestingly, nearly half (47%) of the organizations had mentorship officers, or at the very least, officers who had mentorship as one of their responsibilities. Only 42% of organizations documented mentorship in any way. This is summarized in Figure 2.

Except question 1b (see Table 4 below), these responses varied by student organization type. Participants from professional student organizations were more likely to respond "Yes" to questions 1a, 4, and 5 suggesting a higher level of formalization as compared with interest student organizations. This information is provided in Table 4.

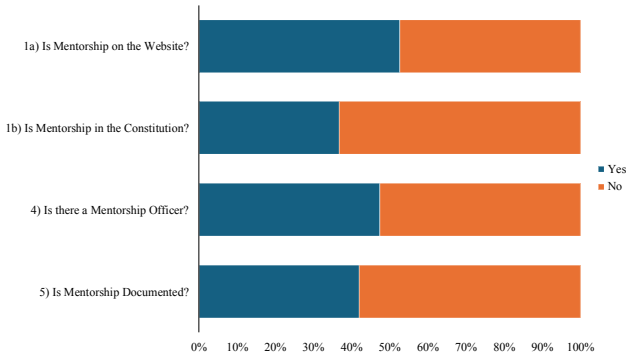

Fig. 2. Aggregated Participant Responses to Questions 1a, 1b, 4, and 5

TABLE IV
RESPONSES FOR QUESTIONS 1A, 1B, 4, AND 5 BY STUDENT ORGANIZATION TYPE

	Professional		Interest	
1a) Is Mentorship on the Website?				
	n	**%**	***n***	**%**
Yes	8	62%	2	33%
No	5	38%	4	67%
Total	13	100%	6	100%
1b) Is Mentorship in the Constitution?				
	n	**%**	***n***	**%**
Yes	5	38%	2	33%
No	8	62%	4	67%
Total	13	100%	6	100%
4) Is there a Mentorship Officer?				
	n	**%**	***n***	**%**
Yes	7	54%	2	33%
No	6	46%	4	67%
Total	13	100%	6	100%
5) Is Mentorship Documented?				
	n	**%**	***n***	**%**
Yes	6	46%	2	33%
No	7	54%	4	67%
Total	13	100%	6	100%

The low numbers of organizations that mentioned mentorship in their constitutions is not surprising as the constitution is a document submitted to the university as part of the registration process and can only be updated through administrative review processes, which may limit organization activities until the document has been re-approved.

A. Implications for Future Work

This study was meant to improve the current understanding of STEM mentorship within the context of post-secondary student organizations by offering a snapshot of the mentoring relationships that existed in this context at a particular institution at a certain point in time. It was not meant to be

an exhaustive study, nor was it meant to provide evidence regarding the quality or quantity of STEM mentoring relationships at this institution. Developing a clearer understanding of mentoring infrastructure in this context is an important first step for researchers studying this area. The findings presented here provide the researcher with a wealth of information to inform future work. Interesting items include the different ways student organizations on campus may be categorized, the appropriate methods to examine student perceptions of mentorship, and what infrastructure exists to support mentorship in various types of organizations as compared to that provided by the parent organizations of professional student organizations.

Future work will continue to dive deeper into the intersection between mentorship and student organizations and explore the other overarching research questions for the types of activities that create effective mentorship for STEM students. The next stage will look at the national offices of professional organizations to see what they provide in terms of infrastructure supportive of mentorship and what they recommend for mentorship occurring at the student chapter level as compared to what is occurring at the local student chapter level. This will enable the researcher to elucidate how the national landscape compares to what is being actuated at the college level. In addition, more student mentoring organizations that fit into the categories for type will be recruited to see how the data changes with the addition of more types of organizations.

B. Study Limitations

1) Participant Recruitment: Despite the strong on-campus presence of STEM student organizations, there were no mathematics student organizations included in the dataset, nor were there any fraternities or sororities represented. Furthermore, there was an over-representation of engineering-related student organizations across the dataset. While this is a limiting factor, it is to be expected as many of the networks along which this study was advertised are related to the engineering profession or the university's College of Engineering.

2) Participant Screening: There was no participant screening process employed, which resulted in interviews with different individuals from the same organization, leading to duplicate data in the quantifiable portions of this qualitative study. While the qualitative data collected through these interviews were still relevant and useful overall, the study would have benefited from a wider variety of organizational representation.

V. Conclusions

This study sought to answer the question, "What types of student organizations have built mentorship into their structures and why have they chosen to do so?" Based on the results, one can conclude that professional student organizations and interest student organizations both have integrated some formal mentorship into their organizational structures. Professional student organizations had much higher levels of formalization in comparison with interest-based student organizations. The second part of this question – the "why" – requires further study and will be explored in future work.

Acknowledgment

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