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Using Peer Mentorship to Improve Experiences of New International Engineering Graduate Students

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Abstract

The number of international students enrolling in U.S. engineering graduate programs continues to increase and currently make up the majority of full-time graduate student populations in most engineering graduate programs. It is also well-documented that international students face additional challenges than their American counterparts when transitioning to graduate school due to the need to acclimate to a new culture and learning environment. As a result, international students are subject to higher rates of academic and social isolation. To fill this gap at Penn State, a graduate women in engineering program implemented a student-led peer mentoring network designed to provide support for first-year graduate students, of which more than 2/3 have temporary visa status. In its first two years of operation, the mentorship network has paired 39 new students with senior-level graduate students from a variety of engineering disciplines. Mentors were encouraged to meet with their mentees on a monthly basis to discuss topics including strategies to manage student-worker duality, navigating challenging advisor or research lab relationships, prioritizing mental health, setting goals and time management, and creating and maintaining social networks beyond the department level. To better understand the effectiveness of the mentorship program, mentors and mentees provided feedback through a survey administered twice during the academic year. Specific prompts included questions to assess the expectations and impacts of the mentorship program on participants. Initial analyses of the survey results show participants building a stronger sense of belonging and connection to the college of engineering. In addition, mentors expressed the importance of finding a platform to sharpen their mentorship skills. Moving forward, mentees will be followed throughout their graduate school tenure to evaluate their level of engagement in engineering-sponsored events, leadership roles, and graduation rates.

Keywords: peer mentorship, international graduate students, attrition, belonging, students' health and well-being

Introduction

The number of international students in public universities in the U.S. has increased significantly over the last decade despite a decrease in overall graduate student enrollment [1]. More than 50% of graduate students in engineering programs are currently international [2]. Coinciding with this increase in international graduate student enrollment is the decrease in the level of health and well-being among graduate students [3]. Graduate students are experiencing higher rates of loneliness, stress, anxiety, and depression as they navigate their graduate programs. Although students who join graduate school are prepared to tackle challenges related to coursework and research, the support for emotional and social challenges related to graduate school is minimal [4]. Graduate students generally experience several challenges related to mental health, research lab environments and expectations related to research productivity, strained advisor relationships, considerations of departure, or systemic biases that impact their successful progress.

International students face additional challenges related to language self-efficacy, demographical separation from social support sources, adjusting to new cultural dynamics, and issues related to visa and employment requirements [2], [5], [6]. These challenges can lead to isolation, higher attrition rates, lack of enthusiasm for the programs of study, and abandonment of the research career path altogether upon graduation [7]. As a result, there is a need for more emphasis on programs that prepare new graduate students to deal with the challenges experienced in graduate school that lead to attrition.

Completion of the doctoral or graduate program is not the only measure of success in graduate school. Statistics indicate the rates of completion are higher in engineering programs compared to other fields [8], but engineering graduate students experience high levels of isolation, anxiety, and disconnectedness from their programs [9]. Although students may persist despite having negative experiences, many still consider these experiences as triggers for departure from the programs. Those who persist in graduate school often abandon research or academic careers in search of alternative paths due to the negative experiences in graduate school [10]. Factors beyond completion need to be included in evaluating success among graduate students. Considerations such as the level of students' well-being, sense of belonging to the program, preparedness to tackle career goals, and positive mental and social health are crucial for success in graduate school [7].

Women and underrepresented minority graduate students are highly likely to have negative experiences or depart from engineering graduate programs due to gender imbalances, systemic biases, and other environmental factors [3], [9]. International students, on the other hand, deal with additional barriers related to residency status, language efficacy, and geographical separation from families among other challenges [7]. These factors hinder the ability of these groups to find a positive environment to thrive in graduate school. Peers play a crucial role in the graduate school journey. Graduate students have found it fruitful to confide in their peers about the challenges they experience within their research labs, departments, or with their advisors [11]. According to Sallai and Berdanier, most graduate students resort to either acceptance or seeking support from peers as a coping mechanism for negative experiences[3].

Despite recognizing the challenging experiences and the beneficial role of support beyond the formal academic structure, less than 40% of graduate institutions in the U.S. have established programs to provide extensive targeted support or peer mentoring for women, underrepresented minorities, and international students, most of which target women and underrepresented minorities [9]. Programs designed for international graduate students are scarcely documented. There is also limited clarity on the impact of both formal and informal peer mentorship programs on the well-being, community building, and sense of belonging among the graduate international students enrolled in graduate engineering programs in public universities within the U.S. [12].

This study addresses the need for programs that cater to the well-being of international graduate students to increase retention and graduation rates. The mentorship program design and findings from this study can help graduate programs prepare for the projected continued influx of international students in the future [2].

Literature review

Mentors play a significant role in the personal and professional development of students across different disciplines. In several graduate programs, mentoring new students in both master's and doctoral programs has proven to alleviate feelings of isolation, disconnectedness, and emotional challenges in graduate school. These mentorship programs also shape the experiences of students [13]. Graduate program experiences can determine the extent to which students feel satisfied with the institution, program, and research areas. Positive experiences encourage an environment for graduate students to thrive, build a community, stay connected with their peers, and have good mental health and well-being throughout the program [14]. The positive experiences, often cultivated through intrinsic and extrinsic support mechanisms, keep the students motivated to persist in the programs of study [7].

Dysfunctions in supervisor-based mentorship [15] and ambiguity in some departmental mentorship programs have led to the need for multiple types of mentors within the academic sphere [16]. This gap leads to an organic emergence of both informal and formal peer mentorship programs among graduate students [17]. When such a peer-based mentorship arrangement thrives, the students find a source of accountability for various coursework and research milestones [17] and a community to grow their social and professional networks. Peer mentorship therefore provides a wider range of support addressing challenges related to the emotional, social, career, and academic experiences of graduate students [12].

Although researchers have examined the impact of peer mentorship on the experiences of graduate students, these studies less often distinguish between domestic and international students. International students experience additional unique challenges that further affect their graduate school experiences in comparison to their domestic peers [18]. Some of these challenges include differences in institutional culture leading to lower language, writing, and leadership self-efficacy, geographical separation and reduced social support from family and friends, language barriers, and adjustment to climatic, cultural, and social differences [6], [7]. These unique challenges result in isolation, disconnectedness, and lower self-confidence among international students [6].

However, studies examining peer mentorship programs designed to support international students still place more emphasis on international undergraduate students. For such contexts, mentorship programs have resulted in improved self-efficacy and individual advancement [19], higher levels of cultural and social adaptation, and positive psychological experiences [5]. In more than 43 studies addressing peer mentorship programs among graduate students across different continents, only one study focuses on interventions to improve the experiences of international students [12]. This study, based in Australia, highlighted the psychosocial and coursework related support provided by the peer mentorship program [6]. This assumption neglects the career and research-intensive environmental challenges and support that peer mentorship should offer to international graduate students. Therefore, there is a critical need to address the limitations in provision and assessment of viability of peer mentorship programs to improve the experiences of international graduate students.

Methodology

A graduate women in engineering program designed and implemented a peer mentorship network intended to support graduate students in the College of Engineering at Penn State. The program obtained IRB approval (STUDY00023846) to evaluate the impact of mentorship on the experiences of participating graduate students to support future planning and implementation of similar programs. This specific paper explores the impact of this peer mentorship network on the experiences of new graduate student participants, a majority of whom are international. We facilitated the intended peer support by pairing new graduate students with more senior graduate students who have been in their programs more than a year.

We used a mixed method approach based on quantitative and qualitative feedback obtained through a Qualtrics survey to evaluate the experiences of the mentees. A set of Likert scale questions ranging from one to five, where one represents a strong level of disagreement and five represents a strong level of agreement were posed to the participants. These questions addressed challenges among graduate students, areas of peer support in graduate school, and impact from the mentoring process. Open-ended data regarding areas of additional support was also included to solicit participants' expectations and experiences not captured in the Likert-scale questions.

We have facilitated the peer mentorship network for two academic cycles. In the first cycle (2023 – 2024), we surveyed the participants once during the academic year regarding the areas of support and the support provided. We also used college of engineering data to determine the retention of all the participants for the following year. For the second cycle (2024 – 2025), we assessed the expected outcomes and actual outcomes for the mentees based on pre-program and mid-point assessment of participants' experiences, which allows a longitudinal data comparison.

Mentorship program design

Participant recruitment

Mentors were recruited before the beginning of the fall semester, through an email invitation sent via a listserv and Teams channel consisting of members of the Graduate Women in Engineering program. Prospective mentors volunteered to participate through a signup form. Upon determining the number of mentors interested in providing peer mentorship, incoming graduate students were invited to participate as mentees through department orientation presentations as well as targeted email invitations to new incoming engineering graduate students. Both mentors and mentees voluntarily submitted their details through the invitation link based on interest in the program. Although the call for mentors and mentees was open to all students, the final participants were predominantly women. In the first year, a total of 37 students participated in the mentorship program, of which over half of the participants were international graduate students. The participant number increased to 39 in the second year with 2/3 being international students as summarized in Table 1.

Table 1: Participant demographics for two cycles of peer mentorship program.

Program Cycle	Role	U.S. Citizens	U.S. permanent residents	International	Total Participants
2023 -24	Mentors	11	1	8	20
	Mentees	5	1	11	17
		43.2%	**5.4%**	**51.4%**	**37**
2024 - 25	Mentors	5	1	11	17
	Mentees	7	0	15	22
		30.8%	**2.6%**	**66.7%**	**39**

Mentor-mentee matching

A one-to-one pairing of the participants matched each mentor to a mentee. The pairing of participants was primarily based on their programs of study or areas of research interests. When that was not possible, interdisciplinarity among different programs was also considered when pairing participants. The signup form included a section for considerations, requests, or comments from participants, which further informed the matching process based on other aspects such as areas of specific support. In the second cycle, some mentors were allocated two mentees to meet the participation demand.

Program introduction workshop

Once the matching process was finalized, we emailed each mentor to introduce them to their mentee and communicate the details of the upcoming one-on-one workshop to meet their partners and set goals for the mentorship relationship. The initial workshop primarily focused on setting the stage for networking among the mentors and mentees, communicating the goals and expectations of the program, and guiding the mentors and mentees in jointly establishing goals for the mentoring relationship.

Peer mentoring circles

At the end of the first mentorship cycle, we made changes to the structure of the mentorship network to address several challenges. Some of the challenges included having fewer mentors than the number of interested mentees, time constraints from the upper-level graduate students, and limited individual exposure on mechanisms for initiating open discussions around certain topics. To tackle these challenges for the second cycle, we introduced peer mentoring circles in addition to the one-to-one mentoring. During each semester, we organized at least one workshop circle to address different topics around peer mentorship and navigating graduate school.

In some instances, faculty members from different engineering programs were invited to facilitate the mentoring circles, where participants discussed their experiences and best practices around the topic of discussion. Circle topics included finding balance in graduate school, building resilience through self-reflection, advisor relationships, and self-advocacy. Resources such as goal setting and tracking journals, books on mentoring and community building, and online resources on building mentoring relationships and thriving in graduate school were distributed during these workshops and group mentoring sessions. Mentors and mentees

generated a list of potential discussion topics to use during the mentoring circles for the second cycle.

Data collection and analysis

In the first cycle, at the kick-off workshop, we collected data from mentors on potential areas of mentee support based on the challenges the mentors experienced during their graduate school journey. During the same cycle, toward the end of the first semester, we distributed an anonymous survey to the mentors to determine the areas of their current peer mentorship focus based on the list generated from the kick-off workshop. The areas identified from this feedback formed the basis of the survey design to determine the expectations from mentees at the onset of the program and experience mid and toward the end of the program. The survey development was guided by the Mentorship Effectiveness scale which uses Likert scale structured questions to assess the outcomes of a mentorship program from a survey of mentees [24]. Our study specifically used a five scale Likert questions on a scale of 1 to 5 based on the level of agreeableness with the support provided using a set of statements derived from the areas of proposed support from mentors. In the survey, 1 represented a strong level of disagreement while 5 represented a strong level of agreement.

At the start of the second cycle in 2024, we issued the developed survey requesting anonymous responses from the participants, distributed through the Qualtrics platform. The survey assessed the expectations of the mentees from the program. A mid-year survey was also distributed at the end of the Fall 2024 semester to assess the experiences of the participants so far. A Wilcoxon Rank-Sum test was used to determine if there were any significant differences in expectations vs experiences from the quantitative data. We used an inductive coding approach to identify the key themes from the open-ended feedback [25].

Results and discussion

The primary aim of the mentorship network was to offer peer support to new graduate students in engineering programs. In the first cycle, we identified different areas of support from the initial workshop with participating mentors. Figure 2 shows the challenges the mentors experienced in graduate school based on their personal journeys. Results reflect a 40% mentor response rate. It is apparent that the peer mentorship mostly fills the psychosocial support requirement often neglected by many advisor-led mentorship programs [17]. In summary, the mentors offered guidance on navigating mental health challenges specific to graduate school, achieving a healthy level of work-life balance, accessing resources around campus, and communicating with advisors as also demonstrated in peer mentorship [6] and graduate school support network literature [4].

To determine the impact of mentoring based on the support received from mentors, we compared results from pre-mentoring expectations of the new graduate students with their attitudes after four months experience in the program. The experiences were determined based on the following seven aspects: access to resources to address challenges, transition to graduate school, social connection, work-life balance, goal consistency, source of accountability, and connectedness to the college of engineering. As shown in Table 2, the mentees entered the program with relatively

high expectations about the program's anticipated outcomes. For example, the median results were either 4 or 5 before the start of the mentoring program and stayed in that range for the mid-survey results.

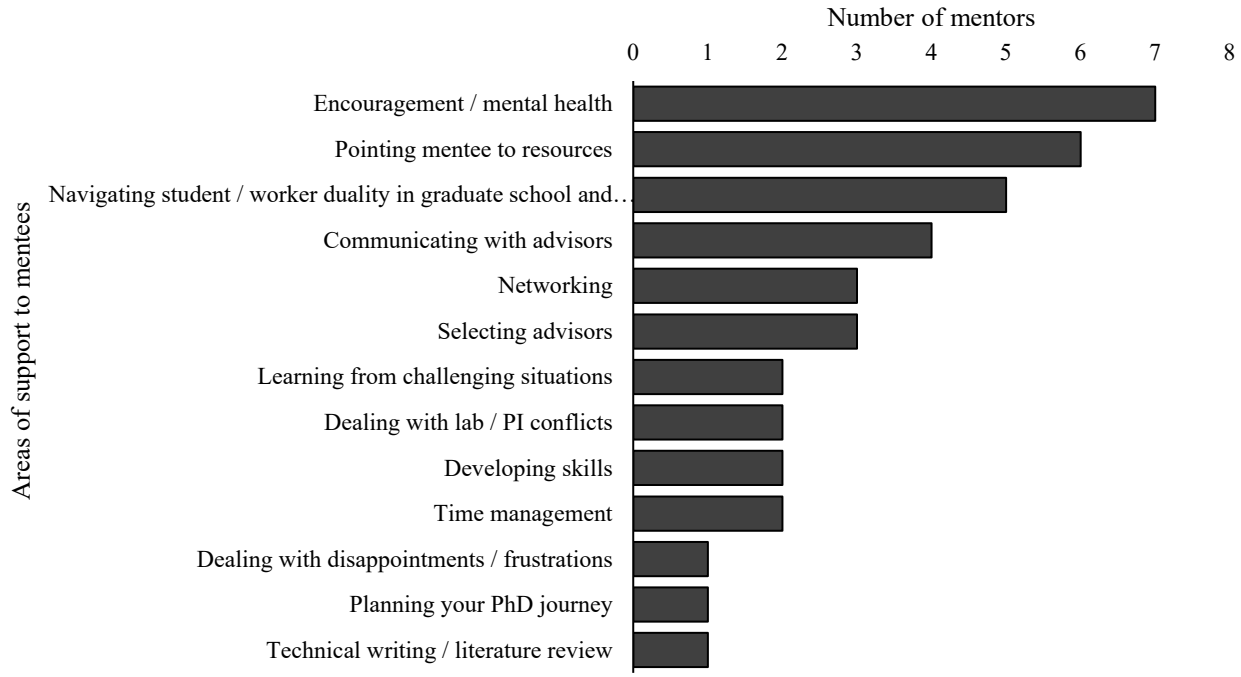

Figure 2: Areas of support for the program mentees as determined by the program mentors who responded to an anonymous survey.

Although, several of the mean values decreased mid-program, a Wilcoxon Rank-Sum test for the unpaired pre- and post-survey responses showed no significant difference (at a 95% confidence level) between the anticipated experience and the actual experience for all seven factors evaluated. This lack of significant difference, where the null hypothesis is true, suggests that the expectations on support and experiences were met to some extent, therefore affording the students a good experience. While we do not have sufficient evidence to conclude that peer mentorship had a significant impact on the experiences of the new graduate students, we can conclude that the program did not significantly underperform expectations. In particular, the mentees received support during their transition and navigating work-life balance dynamics in graduate school. Subsequent surveys may be conducted in the upcoming program cycles using a larger sample size to better validate the impact.

Finally, we looked at the retention data for the first cycle participants. As of fall 2024, all first cycle mentees who started graduate school in 2023 are still enrolled in their respective engineering graduate programs. In addition, all first cycle mentors are either enrolled in their engineering graduate program or have since graduated. We will continue to follow the academic progress of both program cohorts to gain more insight into the impact of the program on graduate student retention and graduation rates.

Table 2. Statistical summary of mentee survey results comparing their pre-mentoring expectations to their actual experiences after four months (mid-program).

Areas of support*	Mean		Standard Dev.		Median		Mode	
	Expected	Mid-program	Expected	Mid-program	Expected	Mid-program	Expected	Mid-program
Resources access	4.54	4.17	0.52	0.75	5	4	5	4
Transition	4.54	4.50	0.52	0.84	5	5	5	5
Social network	4.54	4.00	0.66	1.10	5	4	5	4
Work-life balance	4.38	4.33	0.51	0.52	4	4	4	4
Goals: setting and tracking	4.46	4.00	0.66	0.89	5	4	5	4
Account-ability	4.23	3.83	0.83	0.75	4	4	5	4
Connection to the College	4.62	4.33	0.65	0.82	5	4.5	5	5

*Likert scale for survey responses: 1 = strongly disagree; 2 = somewhat disagree; 3 = neither agree or disagree; 4 = somewhat agree; 5 = strongly agree

Program challenges and lessons learned

Additional feedback from the mentee open-ended responses revealed the need for support in areas not initially accounted for in the survey, such as connecting with professors beyond the advising relationships, getting started on publishing, navigating graduate school milestones, and preparations to obtain internship opportunities. The mentees also expressed concerns about scheduling challenges between the mentor and mentee pairs, unfamiliarity at the beginning of the program which may slow the mentoring process at the onset. Specific concerns attributed to international graduate students align with those seen in other studies, including the fear of not fitting in due to low language and communication self-efficacy [7], [26]. The results also reveal that the current program focuses on offering more psychosocial and environmental support. There are opportunities for nudging the mentors toward providing support on navigating career and academic milestones. These findings inform improvements for the next cycle of the mentoring initiative.

The mentees also identified some limitations related to the program mode of operation. The emphasis was mainly on the formal group meetings and workshops, leading to several suggestions for more informal gatherings or events outside the meeting room setup. A similar desire for community building in a less formal space has been documented elsewhere [27]. Further, the mentees proposed smaller, informal mentor-mentee group meetings to exchange ideas on different approaches to navigating the mentorship journey.

There is evidence of positive impacts of engaging in community building activities on graduate students' experience [28]. For international students, the experience from these programs helps them acculturate through immersive learning. To look for a correlation with college community

engagement, we tracked the mentees' involvement in community-building events organized by the college of engineering and engineering student organizations. Based on event attendance records, the international mentors and mentees attended these types of events less frequently than their domestic counterparts. Since the inception of the mentoring program two years ago, 68% of international student participants have attended zero or one engineering-sponsored community event, whereas 56% of participants who are U.S. citizens attended three or more of these community events. The level of engagement from international students in these activities may be impacted by the level of effort in seeking out and finding opportunities for engagement [29] and the perceived benefits the events have on their academic success [30]. As shown by Pollara, the significant emphasis on graduate school academic priorities by international students may also play a role in this observation [31]. In any case, low engagement of international students in circumstances where these activities and events are readily available has not been sufficiently explored in the literature [31]. Further studies, including in-depth interviews with participating mentees and mentors could help to determine the root cause of this pattern and how it influences the sense of belonging and connectedness to the campus community among international students.

Conclusion

Despite the increasing population of international graduate students at U.S. institutions, there appears to be a lag in university programming to support their specific needs, which may be very different than those for domestic students. To help fill this gap, our study designed a peer mentorship program that could serve as a potential resource to help international students navigate their transition to a U.S. graduate program and improve their general well-being. Use of 1:1 mentorship pairs and group peer mentoring provided several opportunities for new graduate students to interact with upper-level student mentors. Mentees and mentors were both given the opportunity to provide feedback regarding topics of interest, which helped the program meet their expectations. Feedback from the mentees indicated that they mostly either “strongly agreed” or “somewhat agreed” that their expectations from the mentoring relationship were met in seven key areas, including: access to resources to address challenges, transition to graduate school, social connection, work-life balance, goal setting, accountability and connectedness to the college of engineering. For next steps, we plan to collect additional data with larger sample sizes to statistically validate these statements, as well as try to better understand the relationship between survey responses about belonging and demonstrated actions of connecting with others in the college community.

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