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Evaluation of Current Graduate Student Preparation in First Year After Completing the GradTrack Scholars Virtual Mentoring Program as an Undergraduate Student

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Abstract

Mentorship programs play a pivotal role in nurturing the personal and professional development of students. Initiatives such as the UMBC Meyerhoff Scholars [1], Louis Stokes Alliances for Minority Participation (LSAMP) [2], McNair Scholars [3], and GradTrack Scholars [4], [5], programs exist to prepare undergraduate students for graduate school. The GradTrack Scholars program is a comparatively new initiative, and it has evolved over the past 3 years to establish itself as a strong virtual mentoring program committed to the preparation of undergraduate students for graduate school [4]. While GradTrack has demonstrated positive impacts on participants' preparation for the graduate application process, the question remains: what impact does GradTrack have on participants' success once they matriculate into graduate school?

The GradTrack Virtual mentoring program pairs 2 graduate student mentors with 4-7 undergraduate students in mentoring circles with a focus on broadening participation in engineering [4]. In the 3 years of GradTrack's existence, at least 6 seniors have been awarded the NSF GRFP and 65% of senior-level participants have matriculated into graduate programs. A previous assessment of the program showed that GradTrack prepares participating undergraduate students for the graduate application process while helping them build community [5]. An outstanding question is whether this increased community from GradTrack helps students transition to graduate school and succeed in their first semester and/or year. While graduate school transition and support programs exist at institutions across the country [6], [7], [8], this study explores whether GradTrack stretches between the silos of a) undergraduate preparation for graduate admissions and b) graduate school support and success, due to its unique structure of engaging both undergraduate student mentees and graduate student mentors.

The purpose of this study is to understand how undergraduate focused programs, like GradTrack, help set students up for success in graduate school. This study's longitudinal approach follows participants into their graduate studies, providing much needed insight into the longer-term impacts of this program. Through focus groups and survey data, this study assesses the impact of GradTrack program completion on the success of students during their first semester to year in graduate school. We will discuss what topics and structures within the program were helpful for underserved undergraduate students during their matriculation into graduate school. We will also discuss what additional needs students experienced that were not addressed. Results of this study will inform the continued enhancements of the GradTrack program and could lend additional insights and suggestions of best practices into other transition and first-year graduate success programs.

Introduction

Despite the increase in the number of doctoral degrees conferred upon historically underrepresented populations in engineering over the years, the student populations in academia are not commensurate with the diversity of the U.S. population [9]. The U.S. economy is also highly diverse and heavily relies on the STEM workforce to function. With less diversity in training and workforce development, the result is fewer opportunities for minority groups to contribute to the economy, further resulting in a lack of perspectives in decision making processes that affect a population [9]. Only about half of students who enter STEM doctoral graduate programs eventually graduate with the degree [10]. This high rate of attrition has resulted in the development of programs geared towards the students' graduate program completion rate.

There are currently a number of programs that support current graduate students and help graduate students build community, such as Bridge programs [11],[12],[13], Alliances for Graduate Education and the Professoriate (AGEP), the Louis Stokes Bridges to the Doctorate (BD) [6], the Alliances for the Inclusion Across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES) [14], CGS PhD Completion Project [15], Gates Millennium Scholars Program [16], and others. These programs help set students up for success in their careers, complete their graduate degrees, and contribute to the advancement of knowledge and innovation.

Additionally, connecting students to opportunities earlier in the educational pipeline plays a key role in the diversification of graduate student populations as well as their completion rate [17]. Mentorship has been shown to increase students' academic preparation [5], [18]. Programs such as EMERGE [19], the Ronald E. McNair Post-Baccalaureate Achievement Program [3], University of Maryland Baltimore County (UMBC) Meyerhoff Scholars [1], and Louis Stokes Alliances for Minority Participation (LSAMP) [2] provide mentorship and professional development necessary for their preparation for graduate school. These programs have been able to establish impacts beyond transition to thriving in graduate school [20],[21],[22]. This impact is, however, yet to be explored for the relatively newer GradTrack Program. Whereas previous research has demonstrated the effectiveness of GradTrack on undergraduate students' preparedness and entrance into engineering graduate programs [5], the current paper extends this line of research by examining, for the first time, the effect of GradTrack on students' success in their first years of graduate school.

Specifically, our study seeks to explore the following research questions:
- **RQ1.** How do GradTrack alumni perceive how well GradTrack prepared them for the transition to graduate school?
- **RQ2.** How does GradTrack help students with graduate school support and success?
- **RQ3.** What are some recommendations for topics that would be helpful for GradTrack alumni within their first year of graduate school?

This study provides practical foundations regarding if and how the virtual mentorship program prepares alumni who participated in the program to succeed in their first semester to year in graduate school.

GradTrack Scholars Program
GradTrack is a virtual mentorship program that pairs graduate students with undergraduate students in mentoring circles with a goal of broadening participation within graduate engineering. The program has an intentional focus on preparing undergraduate students for graduate school, further increasing their matriculation and retention in Engineering graduate programs and fostering community and sense of belonging among current graduate students. To achieve this goal, graduate student mentors and undergraduate mentees each receive an Action Pack PDF prior to the start of the program detailing monthly activities, milestones, assignments, and templates for different writing materials. Further details about the GradTrack Scholars program, selection process, general structure, including information about the program modifications over the years have been documented previously [4], [5].

Methods

Ethics Statement
Methods were approved by the Purdue Human Research Protection Program and Institutional Review Board (IRB), and all surveys and focus groups were completed in accordance with relevant guidelines and regulations. IRB: IRB-2022-503; *Assessing the effectiveness of the GradTrack virtual mentoring program.*

Participants and recruitment process
The participants in this study consist of GradTrack alumni who had completed undergraduate studies and participated in one of the first two cohorts of the program (2021-2022). A total of 61 seniors were in these cohorts. Surveys were sent to these 61 students with options for alumni in industry and those in graduate school.

"GradTrack alumni" were defined as participants who completed the GradTrack program and who were now no longer in their undergraduate studies. The study participants were recruited through emails and announcements on the program's LinkedIn page. Some alumni were not reached due to inactive undergraduate university email accounts that were deactivated at graduation.

Research methodology
A survey was administered through Qualtrics to alumni with an initial question asking if they were currently pursuing a graduate degree. Those who indicated they were currently in graduate school received subsequent questions including open response and Likert-type questions. Likert responses ranged on a 5-point scale from *not helpful* to *extremely helpful.* The specific questions asked are included in the results below.

A Focus group was held on Zoom to better understand the impact of GradTrack on alumni's graduate school experience. This session was recorded and later transcribed and coded for themes. All responses were kept confidential and de-identified for analysis.

Participants were incentivized with gift cards for completing the survey ($10) and the focus groups ($15). The surveys were anonymous, and responses made voluntary. Upon completion of the survey, participants were redirected to a new survey where they could access the form for the incentives.

Data Analysis

For quantitative survey data, Likert Scale numerical responses were averaged for each question and graphed with error bars, representing the standard error of the mean (SEM).

For ease of discussion, specific questions were grouped into themes, including:
- Sense of Belonging
- Navigating future Mentor-mentee relationships
- Navigating Academics and Research
- Professional Development
- Overall Graduate School Preparation

The exact questions within each theme are represented, and average scores of each group were obtained by taking mean of all items completed and graphed with a dashed line.

Results and Discussion

Sixteen participants who took the survey indicated they were currently in graduate school and were included in the analysis. An additional 2 respondents were not in graduate school and were excluded.

Figure 1. The number of GradTrack Alumni participants plotted by duration in graduate school. $n = 16$ alumni survey participants.

Specifically, half of GradTrack alumni surveyed were in their first semester (less than one year) of graduate studies, 7 alumni were in their first year and 1 student was in their second year of graduate studies (Fig. 1). In terms of degree objective, 14 of the alumni survey participants were pursuing their PhD, while two were pursuing an on-campus master's degree with thesis. Four (4) alumni participated in the online focus group session.
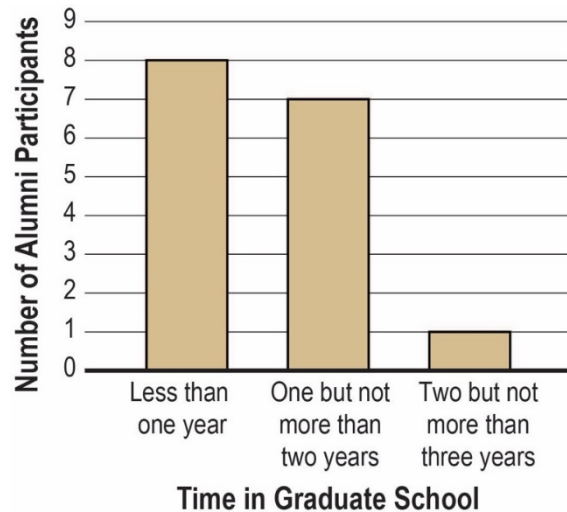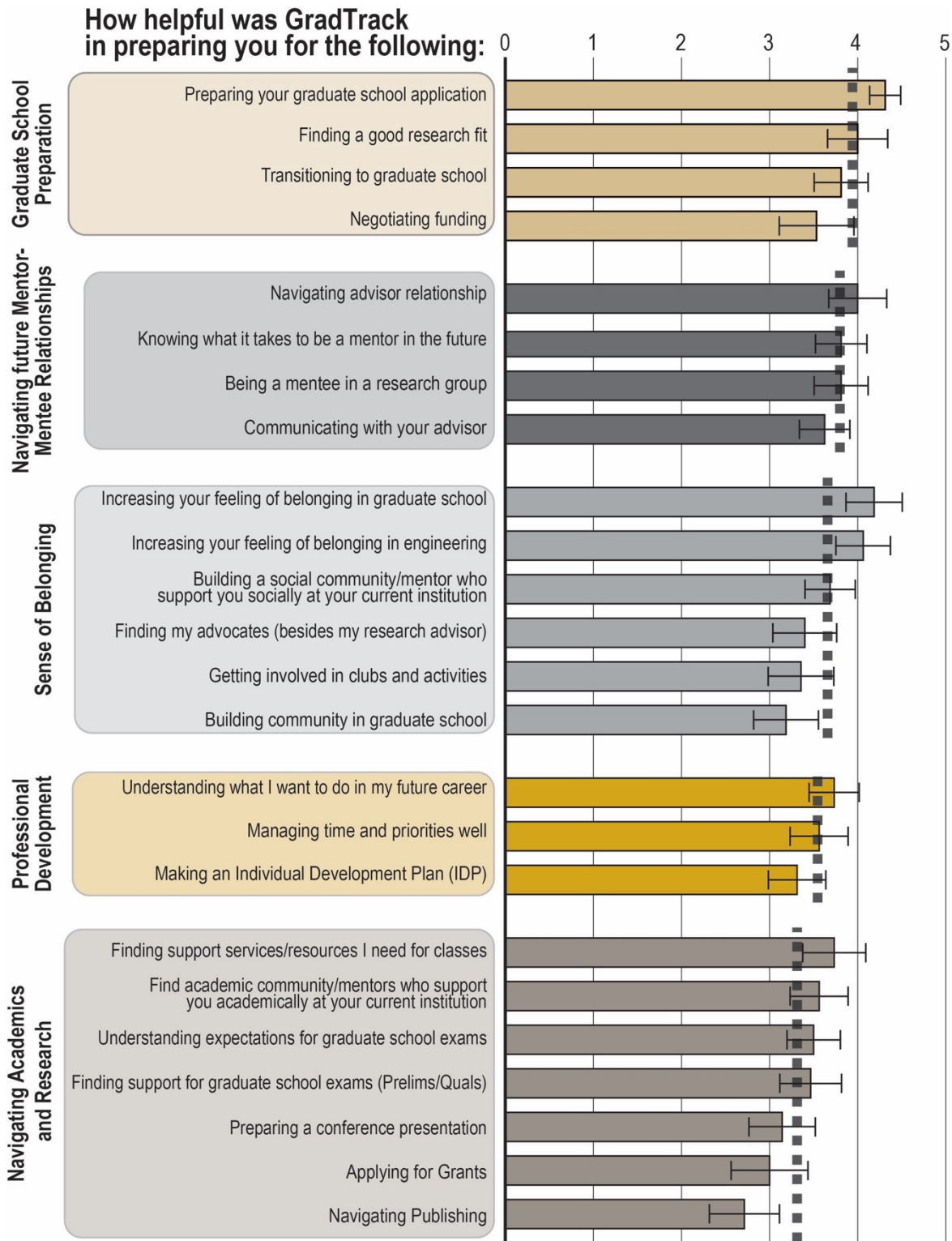
Figure 2. GradTrack alumni feel prepared in Graduate School related areas. Bars represent average score when asked the question on a Likert scale. $n = 16$ program alumni now in graduate school. Dashed line represents mean within the highlighted sub-group cluster/measure. Error bars are standard error of the mean (SEM).

GradTrack alumni who are now in their graduate studies say that the GradTrack program prepared them for the transition to graduate school (RQ1)

Specific questions related to graduate school preparation are grouped in the first block of Figure 2, and the mean for this grouping of questions was the highest of all the measures that were evaluated. Similar to previous findings, the mean score for "Preparing your graduate school application" was one of the highest mean scores of this study (Fig. 2 *mean* = 4.31 ± 0.18). This result can be attributed to the fact that GradTrack's main focus and mission is the preparation of students for graduate school, particularly with their applications. This theme also emerged frequently in student reflections as one of the most helpful aspects of the program. One student reflecting on this said:

"I also found all of the resources, examples, and a timeline of when to accomplish certain graduate school application tasks to be rewarding and allowed me to prepare my applications as best as I could have."

Another student remarked:

"I found completing my application documents and getting them reviewed to be the most valuable part about my GradTrack mentorship experience."

Further, within the theme of graduate preparation and transition, GradTrack alumni indicated that one of the most helpful aspects of GradTrack was having mentors who helped them understand the nuances of finding a good research fit (Fig 2; *mean* = 4 ± 0.34). One example can be seen in the following alumni's reflection on how transparent the mentors were about the matching process:

"I feel like it was a very transparent experience where people were honest with the things that they were struggling with and how they overcame or how they're still working to overcome certain things versus other programs. It's more like cut and dry. Here's how to find a lab, here's how to do this, here's how to do that, but also what happens when you don't like your lab or what happens when the relationship turns sour. So, I feel like learning about those types of aspects were really important."

Another major recurring theme in alumni reflections was GradTrack's impact on easing the transition to graduate school (Fig 2; *mean* = 3.81 ± 0.31). Through the focus groups, we identified three general areas where alumni felt the program helped in their transition: 1) demystifying the graduate school experience, 2) providing field specific information, and 3) offering tips and tricks for survival.

In terms of GradTrack's ability to <u>demystify the graduate school experience</u>, alumni talked in focus groups about how their mentors shared their experiences in graduate school and how this played a key role in their transition. A student said:

"As an undergraduate student mentee in the GradTrack program, I found preparing for/transitioning to the life of a graduate student to be the most helpful. The mentors in the

program were instrumental at pointing out various aspects of the graduate student experience that I never would have thought of but were instrumental for my first-year success."

Another area alumni identified as useful to their transition to graduate school was <u>providing field specific information</u>. For instance, a participant shared how being connected with mentors in their discipline exposed them to various research within that specific area. The student explained:

"I think with me it was having people that were like similar to the field that I was going to or in the field that I was going to. So, they knew a lot about the field, not even just at Purdue, but just like different type of research that was going on, different type of things happening in the field. So therefore, I was able to look at research areas I didn't even consider beforehand, because they knew much more about it. And they knew things going on in the aerospace aeronautics world that I didn't know about as an undergrad."

The third area where alumni found the program most beneficial in their transition was <u>providing tips and tricks for survival</u>. Mentors in the program were required to submit 2-minute video recordings sharing insights on things they wish they had known before entering graduate school. A participant highlighted the usefulness of the tips and tricks provided by mentors, stating:

"Yeah, I think they offered some pretty neat tricks and tips, at least going into my program, where if I hadn't learned those, it would have been a little bit of a learning curve for me. So yeah, it was just nice to have someone that was approachable to offer those kinds of subtle details that maybe I would have missed if I had not participated in the Grad Track program."

Responses with the lowest mean in the first block were for negotiating funding (Fig 2; *mean* = 3.53 ± 0.42) and may point to opportunities for additional resources needed.

Alumni felt GradTrack helped prepare them for certain aspects of graduate school support and success, such as navigating mentor-mentee relationships, sense of belonging, and finding support services, but additional opportunities exist to help prepare them for academic particulars such as grant writing and publishing (RQ2)

Navigating mentor-mentee relationships
The second highest average of the measures that were evaluated was the collection of questions surrounding "Navigating future mentor-mentee relationships" (Fig 2). Alumni from the GradTrack program highlighted how their participation in GradTrack influenced how they approach mentoring during their time as a graduate student. Alumni said that GradTrack provided them with a foundation to establish relationships with other mentees and mentors. One alumnus who is now a mentor, mentioned the importance of coming full circle:

"I was a mentee and a mentor, and I think being a mentee allowed me to know what I wanted as a mentee. So, when I was a mentor I was able to kind of speak to my mentees in the way I would have wanted somebody to like tell me certain things or things I thought were useful."

Another alumnus provided an appreciation for the time it takes to mentor others:

"I think that my mentors in the GradTrack program, they put a lot of time into reading over our essays, answering our questions, things like that. Where now, I'm looking at mentorship programs here at my school. Now I see that time it takes to do these things, especially because it's a volunteer aspect, and so, respecting that more."

Overall, GradTrack helped establish mentoring norms for GradTrack mentees, which aided in the success of GradTrack alumni with other mentor-mentee type relationships in graduate programs.

Sense of belonging

GradTrack alumni suggest that the program also strongly helped them to increase their feelings of belonging in graduate school (Fig 2; *mean* = 4.19 ± 0.32) and as an engineer (Fig 2; *mean* = 4.06 ± 0.31). Alumni noted that participating in the GradTrack mentorship program strengthened their networking skills, feeling of belongingness and aided them in navigating their new community in graduate school. Alumni believe that the sense of community fostered by the GradTrack program helped them develop the confidence needed to build connections even outside the program. A participant said:

"I think it was the networking, like, getting to know the staff [...], and then also my mentor who was also at Purdue afterwards when I came here. Building that connection really helped me. Like when I need something, I know who I can speak to. So it made things a lot more helpful."

This sentiment was supported by another student's response to an open-ended question in the alumni survey.

"I found the community of other GradTrack students and mentors to be the most valuable. I believe "fitting in" and feelings of "belonging" in academia are difficult as a person of color."

Another theme we observed in alumni reflections was the ability for participants to build out their network as well as the enduring benefits of the relationships they maintained with some members of their cohort well after the program ended. An alumnus said:

"I would also like to add that one of the best components of this program was not just the mentors, but also the other people in my group. So just like the peer aspect of getting to know people in my circle, because at the end of the day, they are my colleagues, which I feel so old saying that now. But you know, they're my colleagues. So, like they're going to grow up with me, you know, through my whole graduate process. So now I built a network of people in my field who go to various different schools who have different interests, but I think that was a really key part because now I'm able to build friendships among different people who have the same goal as me. So, yeah, I love this program… don't ever leave, ever."

Professional development

Survey results indicated GradTrack assisted students in understanding what they wanted to do in their future career (Fig 2; *mean* = 3.73 ± 0.28) and managing time and priorities well (Fig 2; *mean* = 3.56 ± 0.33). The specific skill of making an individual development plan, while still above neutral (3.0), was the lowest rated question in the professional development block (Fig 2; *mean* = 3.31 ± 0.33). This could be a practical tool to introduce within future GradTrack programs.

Participants also reflected on the professional development they received from GradTrack and how that has helped them in their graduate program. One student said:

"[...] just learning how to communicate with my mentor is definitely a skill I think I developed during GradTrack and definitely helped here in grad school at least so far.

Navigating research and academics.
The GradTrack program does not focus intentionally on navigating the in-depth specifics of research (applying for research grants, the steps to publish, etc…), and alumni survey results align with this. "Navigating Academics and Research" was the lowest scoring mean measure but are still within the standard error of neutral (3.0)(Fig 2.) Specifically, some of the lowest mean scores were for applying to grants (Fig 2; *mean* = 3.00 ± 0.44) and navigating publishing (Fig 2; *mean* = 2.71 ± 0.40). This find aligns with expectations, as these topics were not the primary focus of the program.

On the other hand, there was a relatively higher mean score for the category of finding support services/resources I need for classes (Fig 2; *mean* = 3.73 ± 0.36), suggesting that GradTrack alumni have learned how to navigate systems needed for success within the classroom. Similarly, alumni positively highlighted features of GradTrack that helped them connect with research advisors, an important first step in navigating their research:

"It was like one of the activities we did in GradTrack about yourself, at least for me, when I was rotating with a few different faculty members before deciding on an advisor, that was pretty helpful for me to at least establish that and establish what I was actually going to say to those faculty members and to objectively portray myself for them to make a decision on whether or not they want to host me for a rotation, before ultimately deciding on which advisor I would go with."

Taken together, these results suggest that while students could benefit from some additional preparation related to specific aspects of research, other areas related to advisor and community relationships are already supported within the GradTrack structure.

Alumni give recommendations for topics that would be helpful for their first year of graduate school (RQ3)

To understand the unmet needs of students in the GradTrack program, we investigated the experiences the program could have offered and ways to enhance it. According to survey responses on a Likert Scale from 1 to 5, over 50% of participants considered all topics to be very helpful (4)

or extremely helpful (5) (Table 1). Thus, any of these topics could be valuable additions to a GradTrack or similar program. To delve into this further, we categorized responses into those greater than the "neutral" designation (scoring 4 or 5) and those equal to or below neutral (scoring 1, 2, or 3). From this categorization, the top three topics that alumni perceived would be most helpful were:

- communicating with their advisor
- navigating advisor relationships, and
- finding advocates (besides their research advisor).

Conversely, they identified that the top two topics they deemed least helpful was making an Individual Development Plan (IDP) and negotiating funding (Table 1). This could point to a lack of understanding regarding the value of an IDP and may point to an opportunity to share additional information. Funding, while a major topic for many students, may be skewed in these results if students were already in guaranteed funding situations; we do not know the funding status of the respondents.

Table 1. GradTrack alumni scores by percentage on how helpful experiences/topics would be for a version of GradTrack focused on first year students

Helpful topics or experiences	Likert score ≤ 3	Likert score 4 or 5
Transitioning to graduate school	13%	88%
Communicating with your advisor	0%	100%
Managing your time and priorities well	31%	69%
Making an Individual Development Plan (IDP)	44%	56%
Building community in graduate school	13%	88%
Finding support for graduate school exams (Prelim, Quals, Defense, etc...)	25%	75%
Understanding expectations for graduate school exams	19%	81%
Finding a good research fit	31%	69%
Navigating advisor relationships	6%	94%
Finding my advocates (besides my research advisor)	6%	94%
Preparing a conference presentation	25%	75%
Navigating publishing	19%	81%
Applying for grants	19%	81%
Negotiating funding	44%	56%
Finding support services/resources I need for classes	25%	75%
Understanding what I want to do in my future career	13%	88%

From the focus group, we derived three additional themes of helpful topics that GradTrack alumni would like to see in their first year including, 1) navigating faculty advisor relationships, 2) how to study a research paper, and 2) how to work independently.

Specifically, <u>GradTrack alumni want more resources to navigate advisor relationships</u>. One of the prominent areas that alumni expressed would be of benefit included the details and expectations regarding how to meet with their faculty advisor:

"I would say for me, the art of an advisor-mentee meeting, I feel like I thought that they would be different than what they are. Like you only get an hour a week. And if, you know, sometimes the advisor is like 45 minutes in rushing out of the door to go pick up her kid. So, I'm like, OK, how do I maximize this hour? Like, what do I put in my slides? What do I say? What do I not say? What do I leave for next week? And so, I felt like this first semester is kind of like, I'm disappointed in myself. I didn't get everything done; I didn't leave with the clear action item. So, like how to navigate, I guess, how to like design the perfect meeting, if that makes sense. But from like the researcher point of view, not from the advisor point of view"

<u>GradTrack alumni want tips and tricks to break down research papers.</u> Another area alumni felt they would have benefited more from was the proper understanding of the best ways to read through and summarize research papers. Referring to this need, an alumnus commented that:

"I think one of the things, especially thinking back if like I were like a younger GradTrack member, would be like how to break down just like a research paper. That was one thing that I think would have been helpful - at least for me - going into like the breaking down, of course, perspective of advisors' papers. [...] We were kind of situated where we kind of had similar research interests in the GradTrack program. So maybe just picking at least like one broad paper, [in] at least one session to kind of break that down and get substantial results that we can then talk about with someone else would be helpful."

<u>GradTrack alumni emphasize the importance of learning to work independently.</u> GradTrack alumni in the focus group highlighted the contrasts between graduate school and undergraduate studies, particularly in terms of workload and responsibilities. For instance, one student described the challenges of transitioning to independent work, stating:

"I think one skill that would have been useful was the concept of independent learning. I think as an undergrad I was like, you know: take courses, follow these tasks as a researcher. You have to really not just follow certain set of tasks, but really try to understand the problem. So maybe problem solving in terms of research."

Another participant also shared that there was a hurdle in learning how to assign oneself a specific task and seeing it to completion. Specifically, the alumni mentioned, *"like sometimes you need to assign yourself work to do, like not everyone's assigning you specific things to do."* This quote dovetails with the importance and need to equip undergraduate students who are transitioning to graduate school with the initiative to advocate for themselves and manage up when necessary.

Conclusions

Overall, this research study demonstrates that there are consistent reoccurring themes within the GradTrack program, including increasing students' preparation for graduate school and increasing a sense of belonging as a graduate student, as an engineer, and to their respective field – supporting

previously reported data [5]. This study also highlights that there are some new themes that are emerging once students complete GradTrack, become program alumni, and then start in their own graduate degrees.

These new graduate student focused themes are what we would call continuous themes: topics that appear to be important to students not only as undergraduate students, but also in their early years of their graduate study (i.e. communicating with a research advisor, navigating advisor relationships, finding advocates (besides their research advisor), evaluating a research paper, working independently, etc…). Many of these are advisor-focused or research-related themes, which occur at both the undergraduate and graduate student levels. These topics are challenging because each advisor works in a different way, but if we can begin to prepare our GradTrack scholars to set expectations and communication plans with their advisors, then addressing this challenge could be a helpful first start.

So what structures are helpful for underserved undergraduate students during their matriculation to graduate school? GradTrack alumni shared the effectiveness of the GradTrack structures including learning how to talk about themselves and their research, breakout circle discussion topics between mentors and mentees, and mentoring relationships (mentor-mentee and peer mentee) in facilitating their transition to graduate school. A student also mentioned the importance of inclusive mentoring structures in terms of belonging in academia as a person of color. While GradTrack alumni suggested that they felt stronger navigating mentoring relationships and communication, then still suggested that they would like more tangible resources in leading a meeting with their faculty advisor. One student suggested that having a template or more formal framework for how to lead an advisor-graduate student meeting would be helpful.

In the future, this data and student feedback can be used to build out mentoring and transition structures to enable the success of underserved students in engineering in the early stages of graduate study. One interesting part of this study was the indifference of current graduate students to Individual Development Plans (IDPs). Based on the literature, this result could be due to the fact that only about 50% of doctoral students are required to complete an IDP [23], [24], and therefore students might not yet be thinking of an IDPs function, utility or connection to career success. Further, navigating academics and research are areas that need attention and there are three potential options for how to address this gap in relation to the GradTrack program: 1) we could add these topics to the current program, 2) develop a whole new program for first year graduate students or 3) create a workshop series for GradTrack alumni. Further, we need to continue to pursue a longitudinal approach to survey and stay in touch with our alumni as they graduate and move into their next step. This will be helpful to learn more about students who are interested in graduate school, but decide to pursue industry careers after graduation instead.

Putting GradTrack into the context of other transition programs, we have shown that GradTrack is a helpful mentoring resource that functions to prepare students for applying to graduate school and also helps in the transition to graduate school. As always, programs such as LSAMP, McNair, AGEP, Meyerhoff Scholars, GradTrack, etc… cannot work in silos. We can maximize impact in supporting student success, community building, and broadening participation in engineering when all programs act together with each another. Specifically, this study provided additional insights into structures that can be implemented in order support the transition and first-year

graduate success of students from diverse backgrounds. We suggest that this should be a consistent source of focus for graduate education professionals, highlighting tangible structures that we can address to broaden participation of early career graduate students.

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