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Preparing BME Master's Students for the Ph.D.: A Targeted Workshop Model

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Introduction: Biomedical engineering (BME) master's students enter graduate programs with diverse goals, including industry employment, research careers, and academic pathways[1], [2]. There are several different types of master's programs institutions offer that are designed for students to achieve one or more of these goals. These programs include research-based thesis programs, non-thesis coursework-based programs, combined BS/MS programs, and specialty medical innovation programs[3]. Specialized medical innovation programs in particular are rising in popularity. They often can take as little as one year, align with the skills and needs desired by industry, and are tailored towards students who wish to enter the workforce upon graduation with their master's. However, recent data from 83 universities suggest that although 40-50% of BME undergraduates pursue industry careers after graduation, approximately 30% attend graduate school, though there is no specification between master's and Ph.D. programs[4]. A 2021 report from the National Center for Engineering and Science Statistics found that there was a 13.4% increase in Ph.D. students in engineering and the health sciences from 2020 to 2021 with increases trending since 2017[5]. Though there appears to be an increasing number of BME Ph.D. students, there also appears to be stronger competition due to decreases in federal research funding[6], a broader financial crisis among U.S. institutions, and a tight job market in the biotechnology and pharma sectors[7]. It is clear that those who wish to apply to Ph.D. programs must be well prepared in every part of their application in order to have a chance at admission.

At Brown University, approximately 25-30% of BME master's students aspire to pursue a Ph.D. Though the majority of our graduates pursue industry careers, our program wanted to provide support for those choosing to pursue further education in the same way that our university provides an abundance of resources to those pursuing industry careers. In advising our Ph.D.-interested students, we found that few discipline-specific resources exist to guide students through the complex application process. To address this gap, our BME program developed a "Pathway to Ph.D." workshop program to provide targeted mentorship, funding opportunities, and structured workshops focused on navigating the Ph.D. application process both at external institutions and our own institution. This initiative was designed both to increase transparency around doctoral pathways and to enhance student competitiveness in admissions.

Workshop Motivation: The "Pathway to Ph.D." program was structured as a selective internal program with defined eligibility requirements, including full-time research status in the M.S. program and active engagement with a research advisor. The program's selective nature ensured that participating students were committed to investing the time and effort required to present their strongest possible Ph.D. applications. This selectivity helped position students for success in the program. Studies show that similar workshops have successfully helped graduate students gain confidence, expertise, and support in related topics, such as graduate student professional development, grant writing, and dissertation writing[8], [9], [10]. BME master's program leadership hoped that the "Pathway to Ph.D." program would achieve the following goals:

(1) Increase clarity about pursuing a Ph.D. in Biomedical Engineering
(2) Improve understanding of the BME Ph.D. application process
(3) Build confidence and self-efficacy in preparing Ph.D. application materials

(4) Support identity development as emerging biomedical researchers
(5) Assess the impact of a structured, discipline-specific advising model on students' Ph.D. preparation

Students applied through a process requiring a personal statement, transcript, and advisor recommendation. Applications were reviewed by a committee of BME faculty based on the following five criteria: (1) Motivation for pursuing a Ph.D. (2) Research experience (3) Plans to apply to a Ph.D. (4) Academic Potential (5) Recommendation from PI. Each of these five categories was evaluated on a five-point Likert scale with 1=weak, 2=below average, 3=adequate, 4=strong, and 5=outstanding. Organizers used this application process to select students who met eligibility requirements and demonstrated strong motivation. The selection process also aimed to build a collaborative cohort of students with a shared interest in pursuing Ph.D. programs. An additional incentive of applying to the program was that applicants were also eligible for a Summer Research Stipend (SRS) to support full-time research activity during the summer months between the first and second years of their M.S. program. SRS recipients were selected based on their application review scores. Although organizers would have liked to give everyone in the program an SRS, this was not feasible due to budgetary constraints. We aimed to provide as much financial support as possible for master's students' research as they currently do not receive compensation for their research work. It should be noted that the program can be administered without this stipend. Once accepted to the program overall, students gained access to a six-part workshop series spread over 8 months (May to January) to coincide with the Ph.D. application cycle of most institutions.

Workshop Structure: The six workshops in the Pathway to Ph.D. program included: (1) *To Ph.D. or Not to Ph.D.?* (2) *Demystifying the Ph.D.* (3) *Application Process* (4) *How to Write an Awesome Personal Statement* (5) *Individual Personal Statement Editing Session* (6) *Program Reflection and Debrief*. Each 60–90 minute workshop was facilitated by Brown University faculty and staff and designed around insights from the literature[11], [12], [13]. All workshops ended with a brief survey regarding the content and effectiveness of the workshop. Data on Ph.D. acceptances from this cohort will be collected and analyzed in relation to historical acceptance outcomes of BME master's students. Below includes a summary of each workshop, including workshop activities and suggested resources.

(1) ***To Ph.D. or Not to Ph.D.*** given by Dr. Kareen Coulombe and Dr. Marissa Gray
Purpose: To increase students' confidence, clarity, and intentionality when considering doctoral study through structured reflection and peer-supported discussion.
Activities: Guided discussion questions with peers, skills value ranking activity based on values in the "real-world" and graduate school, Individual Development Plan (IDP) as an introduction to evaluate academic and professional goals[14].
Preparation for next workshop: Complete IDP

(2) ***Demystifying the Ph.D.*** given by Dr. Kareen Coulombe and Dr. Marissa Gray
Purpose: Reduce ambiguity and anxiety surrounding the Ph.D. pathway by providing clear, experience-informed insight into doctoral education in BME.
Activities: Complete table of Ph.D. milestones by year and have students research a specific program, open-ended discussion questions regarding topics like funding mechanisms, advisor-student relationships, and traits of successful students.

Preparation for next workshop: Develop a preliminary list of schools and Ph.D. programs of interest

(3) ***All About the Application*** given by Dr. Anita Shukla and Dr. Marissa Gray
Purpose: To enhance sense of preparedness, organization, and confidence in navigating the Ph.D. application process through structured guidance and planning.
Activities: Open discussion regarding application components and evaluation, practice framing research contributions and skills, strategic selection and preparation of letter writes, drafting communications with potential research advisors, and developing a personalized application timeline and plan.
Preparation for next workshop: Complete provided Ph.D. application tracking sheets and planning tools.

(4) ***All About Personal Statements*** given by Dr. Marissa Gray
Purpose: Enable students to identify key components of an engineering personal statement, build confidence in articulating experiences and motivations, provide practical writing strategies and tips, and encourage students to begin writing a draft of their personal statement.
Activities: Viewing and critiquing personal statement examples, searching for sample personal statement prompts and developing drafting strategies for these prompts, open discussion of tips and tricks for writing, reviewing available resources to aid with writing.
Preparation for next workshop: Complete a draft of a personal statement

(5) Individual Personal Statement Editing Sessions
Purpose: Enable students to move from early Ph.D. personal statement drafts to polished personal statements through individualized, expert-guided revision.
Activities: Meeting with program directors, the student's research advisor and/or the Writing Center to receive individual feedback on personal statement drafts.
Preparation for next workshop: Complete revisions and repeat the editing sessions or complete a submission-ready statement as part of the Ph.D. application.

(6) ***Program Reflection and Debrief*** given by Dr. Marissa Gray and Michael Donohue
Purpose: Help students integrate their experiences from the Pathway to Ph.D. program and transition from application preparation to the next phase of their academic or professional journey.
Activities: Individual written reflection regarding the Ph.D. application process, small group discussions surrounding the process as a whole and uncertainty surrounding the outcomes, and large group discussion regarding reframing outcomes and next steps.
Wrap-up: Complete program feedback and keep program organizers informed regarding results of the application cycle.

Results: The first Pathway to Ph.D. cohort was accepted in March 2025 and included fourteen BME master's students, all graduating in Spring 2026. Applications were reviewed by a committee composed of three BME faculty. Based on the aforementioned criteria, all applicants that met eligibility criteria were admitted to the program. Five exceptional applicants that received the top review scores received a $5,000 stipend as compensation to conduct research in

the summer between their first and second years. Prior to the start of the program, every student planned to apply to Ph.D. programs in Fall 2025 for a Fall 2026 start. At the end of the program in January 2026, thirteen of the fourteen Pathway participants applied to at least one Ph.D. program with the remaining participant planning to apply in the future. Workshop attendance remained strong but did decline throughout the program. For example, there were at least 10 students per session for the first three sessions, but numbers dwindled with sessions four through six with about 6-8 students participating. By the end of April 2026, eight of the thirteen students (62%) that applied to Ph.D. programs accepted offers of admission.

Throughout the course of the program, students from other engineering disciplines were very interested in the series and eight of these students were invited to workshops 3-6. The workshops were still BME Ph.D. program-specific, but there were many parallels to those applying to other engineering (or related) Ph.D. programs.

Program effectiveness was evaluated using IRB-exempt post-workshop surveys administered after each session and a brief end-of-program evaluation. Survey items focused on students' perceived clarity, confidence, and preparedness related to the Ph.D. application process. Given the exploratory nature of this program, results are reported using descriptive statistics and representative student comments.

Although each survey collected multiple forms of feedback, key post-workshop results are summarized in Table 1.

Table 1: Summary of Post-Workshop Survey Results

Workshop	**Key Outcome**	**Responses**	**% Agree/Strongly Agree**
1. To Ph.D. or Not to Ph.D.	Increased clarity about pursuing a Ph.D.	14	79%
2. Demystifying the Ph.D.	Understanding Ph.D. structure and expectations	13	54%
3. Application Process	Increased confidence in preparing applications	9	44%
4. Personal Statements	Improved ability to communicate research goals	8	63%
5. Editing Sessions	Strengthened personal statement quality	4	100%
6. Program Debrief	Ability to reflect and identify next steps	7	86%

Students reported increased confidence and clarity over the course of the program, rather than as a result of any single workshop. In fact, confidence and clarity of the Ph.D. application journey

fluctuated based on topic, with the last three workshops seeing a high degree of confidence and clarity among participants. It's also important to note that decreasing attendance may have an impact on survey results and scores. The first three workshops were conducted throughout the summer months while the last three workshops occurred throughout the fall semester and winter break which are particularly busy times for students.

Responses to open-ended questions were especially thorough and enlightening, with students listing many items they learned and valued while also giving valuable feedback. After Workshop 1, one student noted that "*Community, active communication, and creating/maintaining connections are areas I should be putting more effort into*." Following the application-focused workshops, another student shared, *"I felt that the editing sessions helped me convey my research in a way that was easy to understand and not too technical."* After the last debrief workshop, a student summed up their experience with the process saying, "*This process allowed me to reflect on all of my academic, research, and professional experiences which has shown me how much I have grown over the past several years*." Many other students in the session agreed with this statement and expressed similar sentiment after completing the application process, regardless of the outcome.

Participants also suggested specific improvements to the workshops. Many of these comments had a common theme of suggesting more time for hands-on work or use of the tools we introduced. A Workshop 1 participant suggested that organizers "*Block out time to work on the IDP*" that was introduced as a planning tool. In Workshop 2, a participant noted that information regarding "*fellowships and funding would have been better in a separate workshop*" due to current federal funding stressors, but that same participant also noted that this may not be as urgent of an issue in the future. After the more application-specific workshops, participants suggested *"templates or strategies to contact potential PI's"* and "*more time writing and reflecting"* during the writing-specific workshops.

Overall, five of seven students (71%) who attended Workshop 6 believed that the Pathway to Ph.D. program was either extremely or very valuable to their Ph.D. preparation and decision making. Workshops 2, 3, and 4 received the most votes of "most valuable workshops." Collectively, participant feedback indicates that the Pathway to Ph.D. program provided meaningful guidance, reflection opportunities, and discipline-specific preparation for students navigating the Ph.D. application process.

Discussion: As this was our first workshop series targeted to BME master's students who are interested in applying to Ph.D. programs, organizers had much to learn about the participants' experience. Upon soliciting and receiving applications, we immediately learned that program participants are extremely motivated and committed to applying to Ph.D. programs. We originally designed the first two workshops to help students decide whether to apply and how to frame their application, but the vast majority of students had already made that decision. Based on this observation, we may consider revising the first two workshops for the next cohort by giving students more workshop time to use the materials we introduce. However, organizers still recommend these sessions, particularly because the reflections and introspective thinking encouraged by the first two workshops will help inform the application materials presented in

later workshops. We also were concerned that the inclusion of an SRS for some participants would create an imbalance in our cohort. Ultimately, this did not appear to be the case as we did not receive any direct feedback about this. However, we do suspect that those with SRS funding may have been more motivated to attend the sessions than those that did not.

At the end of the 2025-2026 admissions cycle (April 2026), eight of the thirteen students that applied to Ph.D. programs both at Brown and externally had been accepted to and committed to various institutions. Three of those students committed to attending Brown University for their Ph.D. while the remaining five committed to external institutions. Table 2 shows how the data of our first Pathway to Ph.D. cohort compares with previous graduating BME master's students at Brown.

Table 2: Ph.D. Application and Acceptance Data of Brown BME Master's Students

Cohort (Year Applied)	Students Applied	Students Committed	% Students Committed
2025-2026 (Pathway)	13	8	62%
2024-2025	8	4	50%
2023-2024	7	3	43%
2022-2023	3	2	67%

This data reveals that the Brown BME master's program had one of its highest Ph.D. success rates in four years, even while overall enrollment in our program remained quite steady (between 60-75 total students). More interesting is that significantly more students were interested in applying to Ph.D. programs, potentially because of the Pathway to Ph.D. program itself. We also experienced higher success rates even as the Ph.D. landscape became more competitive. There are limitations to this data, including the relatively small number of students that have applied to Ph.D. programs in the past. It would also be advantageous to analyze additional cohorts of students prior to 2021. In the future, we plan to compare this year's data with the Ph.D. commitment rates of upcoming Pathway to Ph.D. programs. We also plan on including more information about how we advertise the program to prospective students and how we change the program to better meet students' needs.

To complement these outcome-based findings, we examined student feedback to better understand participants' experiences within the program. We found that the qualitative feedback and open-ended survey responses were much more valuable to us than the quantitative components. The major themes of student feedback included more hands-on activities, more information about research experiences and how to leverage these experiences throughout the application, and how to adjust the structure of the program to be more inclusive and customizable.

Based on this point, program organizers have been considering how to broaden the audience of this program while still including discipline-specific information. With our initial cohort, we did

have eight non-BME engineers or physicists join the sessions. Anecdotally, these students found the workshops useful because of similar expectations across engineering-related Ph.D. programs like program and application structure, personal statement organization, and connecting with professors as part of the application process. Future iterations of this workshop series could include a common core structure with break-out groups of various disciplines. The addition of discipline-specific and interdisciplinary break-out groups has worked well for similar workshops related to Ph.D. dissertation writing [15]. We also plan to incorporate customizable components, such as opportunities for students to connect with Ph.D. or postdoctoral trainees of their choosing to review application materials. Lastly, many students gave us feedback regarding the scheduling of the workshops. It is very difficult to find a time that everyone can attend, but polling at the beginning of the program and also offering alternate or online options (which were not available this year) may be helpful in retaining participants throughout the program. Tracking student attendance and participation may help us better measure outcomes in future iterations of this program.

Conclusions: Overall, this work demonstrates how a discipline-specific yet adaptable workshop model can support graduate students' navigation of the Ph.D. application process. We are considering how to balance this discipline-specific nature while also remaining flexible enough to serve broader and interdisciplinary student populations. Throughout the course of the program, organizers and instructors observed evidence of improved application quality, particularly in personal statements and recommendation letter planning. Collectively, these findings position the Pathway to Ph.D. model as a promising and scalable approach to supporting master's students pursuing doctoral education.