# Implementing the hidden curriculum for biomedical graduate research trainees: leveraging qualitative data and student affairs personnel to develop soft skills

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Biomedical graduate research trainees are increasingly pursuing careers beyond academia in response to limited academic positions relative to the trainee population. Biomedical research training must therefore evolve alongside the shifting career landscape by circumventing a "hidden curriculum" to help trainees develop skills complementary to existing graduate training. Here, we describe an approach to implement "soft skills" training for a diverse population of biomedical graduate research trainees from the Duke University BioCoRE program. Qualitative data from the BioCoRE annual program survey revealed that trainees felt they were not meeting crucial benchmarks in areas often absent from graduate training. Responses to open-ended survey questions overwhelmingly focused on "soft skills," including communication, conflict resolution, and time management. Using these themes as a guide, the BioCoRE Program Director and graduate student-led Professional Development Committee collaborated to design a monthly workshop series, enlisting support from human resources personnel, undergraduate student affairs offices, and senior graduate trainees with relevant expertise. The year-long workshop series covered a range of topics: personal branding, science communication, scientific storytelling, conflict resolution, time management, and job market preparation. Based on survey data, the inaugural series was well-received and cited as highly effective by attendees. Survey dissemination and analysis will continue in subsequent years to address new topics and anticipate emerging themes in the shifting career development landscape. Implementation of this workshop series demonstrates the ability of graduate programs to enhance trainee soft skills by leveraging the expertise of internal and local professional personnel.

KEYWORDS

soft skills, hidden curriculum, BioCoRE, graduate training, career development, BUILD-U

## Introduction

The traditional academic apprenticeship model for training tenure-track faculty members has significantly evolved and expanded in recent years (Bent, 1959; Goldman and Massy, 2001; Austin, 2009; Minshew et al., 2021; Ganapati and Ritchie, 2021; Glazer and Hannafin, 2006; Maher et al., 2013; Sinche et al., 2017). In the current biomedical research landscape, trainees must prepare for a "branching career pipeline" due to

the scarcity of tenure-track positions compared to the surplus of doctoral graduates (Sinche et al., 2017; Fuhrmann et al., 2011; Wood et al., 2020; Leshner and Scherer, 2019; Alberts et al., 2014). Consequently, trainees are increasingly interested in pursuing non-academic careers. Successfully navigating this transition requires an assessment of which skills acquired during doctoral training are transferable to both research-intensive and non-research-intensive roles outside academia (Sinche et al., 2017; Gibbs et al., 2014). On the other hand, "soft" skills are also critically important for trainees pursuing academic careers (José Quintans-Júnior and Correia, 2023). According to a 2018 report by the National Academies of Science entitled "Graduate Stem Education for the twenty-first Century," an ideal STEM education should include a "student-centered" curriculum that focuses on the diverse needs of student trainees and should focus on providing students with resources to explore diverse career options (National Academies of Sciences Engineering Medicine, 2018). Yet trainees must seek out opportunities to develop "soft" skills, often as part of a "hidden curriculum," to enhance their employability post-graduation and reduce reliance on temporary positions (Margolis, 2001; Mackin et al., 2019; Enders et al., 2021).

This hidden curriculum consists of unspoken rules, standards, and cultural phenomena inherently understood, and more easily accessible to students from circumstances familiar with these conventions. The hidden curriculum may include both practical skills such as self-advocacy or conflict mediation as well as technical skills such as data management. Students unfamiliar with the hidden curriculum then may be subjected to backlash and disappointment from peers and/or superiors due to perceived lack of professionalism, lackluster deliverables, and unmet expectations. For students unfamiliar with it, navigating the hidden curriculum can be confusing, and may lead to adverse outcomes within their doctoral training programs (Enders et al., 2021; Hafferty, 1998; University ToB, 2021).

In recent years, federal agencies such as the National Institutes of Health (NIH) have implemented initiatives like the Broadening Experiences in Scientific Training (BEST; Scalo and Freauff, 2020; Mathur et al., 2018; St. Clair et al., 2017) award program to support institutions in offering career exploration opportunities for biomedical research trainees (St. Clair et al., 2017); however, not all institutions are equipped with such programs. Furthermore, while some institutions and faculty acknowledge the necessity for trainees to actively develop aspects of the hidden curriculum, including communication, time management, and teamwork (Khan, 2019; Demaria et al., 2018; Lenhart et al., 2022), these efforts are not uniformly implemented across all departments or laboratories.

It is suggested that graduate students should navigate their institution's organizational culture to acquire these skills by trial and error, but this can be challenging given their limited time (Callier and Vanderford, 2014). Several studies indicate the increasing relevance of soft skills development across professions, further underscoring the importance of supporting this aspect of student professional development to obtain positions beyond academia (Sinche et al., 2017; St. Clair et al., 2017; Moreira et al., 2019; Schmidt et al., 2023). To compete effectively across diverse career paths, biomedical research trainees must adeptly acquire and combine these skills to complement their disciplinary training.

The term "soft skills" was initially coined for military use by Whitmore and Fry in 1974, defining it as "important job-related skills that involve little or no interaction with machines and whose application on the job is quite generalized" (Whitmore and Fry, 1974). In today's academic context, soft skills are more broadly understood as interpersonal or non-technical skills that emphasize human interaction (Bourdieau, 1988; Berdanier, 2022). Moreover, the term "hidden curriculum" traces back to 1968, coined by Phillip Jackson to describe the implicit rules, norms, and values within a learning environment (Jackson, 1968). The soft skills crucial for enhancing employability among biomedical research trainees are often embedded within the hidden curriculum of higher education.

In contrast, "hard skills" or technical skills, such as laboratory techniques or computational approaches, are explicitly taught to students throughout their tenure as research trainees in biomedical science disciplines. While biomedical graduate education has traditionally been aimed at preparing students for the academy, an increasing number of students have trended toward alternative and non-traditional career paths post-graduation. These choices have illuminated the importance of developing soft skills as transferrable competencies that serve both students, and potential future employers. While hard skills are central to Ph.D. training, traditional academia has also highlighted the need for soft skills within its own purview. Within the biomedical sciences, collaboration, clear communication, time management, and conflict management have all become necessary inter- and intrapersonal skills; yet, for many students there is often very little recourse in developing these skills.

Within the Duke University School of Medicine (SoM), the IDEALS (Inclusion, Diversity, Equity, Advancement, and Leadership in the Sciences) Office, directed by the Associate Dean for Equity, Diversity, and Inclusion in the Basic Sciences leads the SoM's diversity and cultural awareness initiatives for trainees, faculty, and staff working in basic science research labs. IDEALS develops and implements educational and programmatic resources to support equity, diversity, and inclusion, and exists to cultivate a strong sense of belonging within the research community. One such initiative, the BioCoRE program, supports graduate trainees through a series of programs including professional development opportunities, academic enrichment groups, mentoring programs, and social activities.

The Biosciences Collaborative for Research Engagement (BioCoRE) program at Duke University School of Medicine supports biomedical research trainees of diverse backgrounds (Supplementary Tables 1–3) beyond their departments and labs. Participating students receive leadership, mentoring, and career development through tailored workshops and events with the goal of equipping graduate students across STEM disciplines with the skills and knowledge necessary to successfully matriculate through and complete doctoral programs in a robust community of support. While originally funded by the NIH from 2012 to 2017, the BioCoRE program now operates based on institutional support, and it currently accommodates ninety BioCoRE scholars, ranging from 1st- to 8th-year students, with appointments beginning before the start of the 1st year of the doctoral program. To assess the effectiveness and relevance of BioCoRE programmatic offerings in an ever-changing training landscape, an
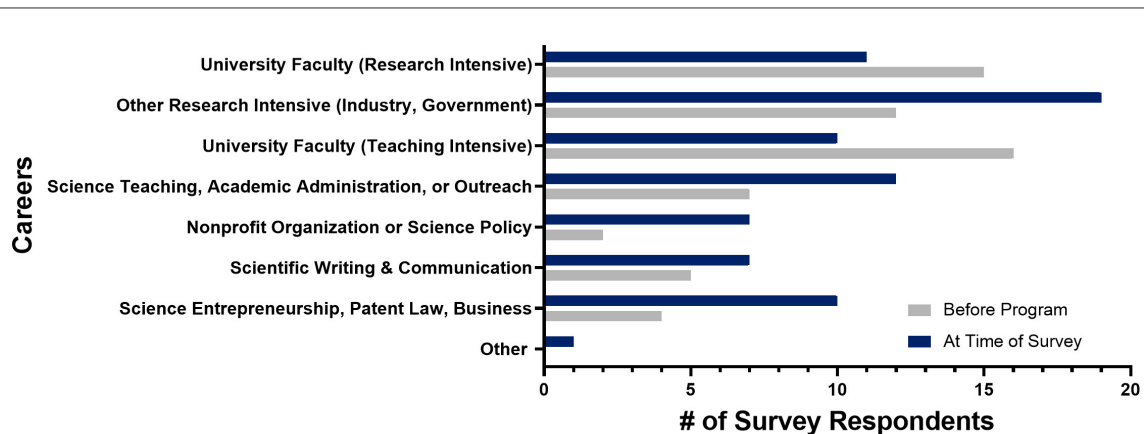
FIGURE 1
2023 career aspirations of survey respondents before program start and at the time of the survey. Survey respondents demonstrate variability in potential career outcomes illustrating the need for "soft skill" development.

annual survey is disseminated to participants to gather feedback to augment ongoing programs and identify topics for future training implementations.

Scholars in the BioCoRE program have shown evolving perspectives on their career pathways from their initial stages of graduate school to their current studies (Figure 1). Additionally, students have identified several ways in which the BioCoRE program specifically can address or enhance the support and skills development opportunities available through their primary training program/department and other campus resources. Armed with this knowledge, BioCoRE program leadership identified and created strategic partnerships with various student affairs offices at our institution to address key themes identified in the annual survey. A review of survey data identified essential soft skills development as a high priority among BioCoRE participants. By collaborating with student affairs offices across the institution, we designed a curriculum tailored to our specific students' needs. Additionally, by leveraging our own "in-house" resources, we were able to introduce students to specific staff and departments with which they were not previously aware of or familiar with, opening the door to individual student-specific follow-ups.

Through thematic analysis, we identified several skills—including communication, conflict resolution, and time management—on which to focus further development. These skills are widely recognized in literature as crucial for employability (Sinche et al., 2017; Khan, 2019; Demaria et al., 2018; Schmidt et al., 2023). Leveraging thematic analysis and collaborating with the student-led BioCoRE professional development committee, we developed the BioCoRE Upskill Institute for Learning and Developing Students (BUILD-U) workshop series. The ongoing aim of this initiative is to equip students with various soft skills, thereby enhancing their employability.

In this paper, we explore how institutions and their departments can enhance soft skills training frequently embedded within the hidden curriculum for biomedical graduate trainees, irrespective of their discipline or year of study.

## Methods

This study was completed in compliance with the Duke University Health System's Institutional Review Board (DUHS IRB) standards of ethical research (Protocol Reference ID #116259-INIT-1.0).

In the summer of 2023, scholars participating in the BioCoRE program were invited to anonymously complete an electronic survey using Qualtrics Experience Management (XM) software, licensed through the Duke University Health System. In the Duke University School of Medicine, there are ~646 biomedical graduate trainees across 17 biomedical PhD training program departments. Of those, 98 students we participated in the BioCoRE program by the end of the 2022–2023 academic year, 29 scholars (30% response rate) completed the annual BioCoRE program survey in its entirety. The survey included various question types such as multiple choice, Likert-scale, and open-ended questions. Among the respondents, more than half had recently finished their 1st or 2nd year of study [$n = 19$, with 11 rising 2nd years (58%) and 8 rising 3rd-years (42%) (Figure 2)]. It is important to note that while demographic information is collected from student respondents, no other information that would explicitly identify students is collected to ensure that the responses are as honest as possible. Cohort information (entering year) is collected to incentivize student response rate as the cohort with the most responses gets to choose from a list of pre-selected "prizes."

A thematic analysis was conducted on responses to open-ended questions to guide general programming for the 2023–2024 academic year in BioCoRE. However, the specific question that highlighted the need for more soft skills programming was: "*What additional programs, services, and skills development should BioCoRE provide?*" Out of the 29 responses received for this particular question, 41% ($n = 12$) provided actionable feedback beyond "NA."

The BioCoRE program director reviewed these responses and identified key themes such as conflict resolution, time management, and communication. These themes were shared exclusively with senior scholars on the BioCoRE professional
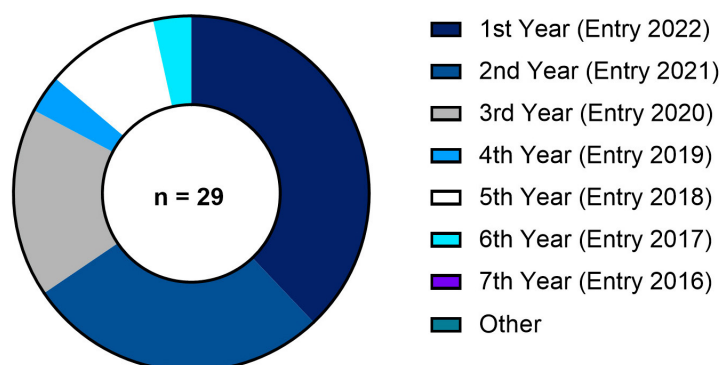
FIGURE 2
Survey respondents by cohort (2022–2023). Survey respondents were composed of students from multiple program years, demonstrating respondents' desire to participate in BioCoRE programming. Importantly, many earlier-program students participated in the survey, illustrating the desire for "soft skills" from students of all years.

development leadership committee. This initiated the planning of a workshop series offered to all BioCoRE scholars in the upcoming school year beginning in September 2023. Following this, the professional development committee leaders reached out to both internal and external leaders to organize the BUILD-U workshop series. These workshops, scheduled monthly over lunch, were attended by scholars ranging from 1st to 5th year of study, with a minimum of 20 participants per session.

## Results

### Workshop series development

In late summer 2023, the student-led BioCoRE Professional Development Committee and the BioCoRE Program Director began identifying professionals and leaders both on and off campus with pertinent backgrounds and expertise to effectively address themes identified in the annual survey using their professional networks (Figure 3). To encourage workshop participation and accommodate student schedules, workshops were scheduled monthly from September to April, with breaks in December and February for holidays and School of Medicine Ph. D. program admissions activities, respectively. These six workshops were hosted over a provided lunch at a centralized location easily accessible to School of Medicine students. Topics from the 2022–2023 annual survey were given priority based on the availability of personnel at the university.

### Conflict management

To enhance students' conflict resolution skills, the professional development committee chairs considered campus leaders from Human Resources and the Office of the Ombudsman before deciding to approach the Assistant Director of Human Resources at the university about leading a session. The goal of the session was to develop a framework to help students advocate for themselves, ask for constructive feedback, and resolve common conflicts that arise in biomedical research laboratory environments. The session

involved a large-group discussion covering these objectives, with opportunities afterward for specific advising and guidance among individual students.

### Personal branding

For guidance on building a personal brand, networking, and public speaking, the committee chairs sought expertise from an experienced entrepreneur affiliated with Duke University's Fuqua School of Business, known for hosting an esteemed elevator pitch competition on campus. Attendees learned how to craft and revise short elevator pitches about their research and life aspects and practiced sharing them one-on-one with their peers. Lastly, students had the opportunity to present their revised pitches to the larger group to illustrate effective aspects of a pitch for connecting with an audience and building a brand.

### Time management

To equip students with tools for effective time management, the committee asked a learning consultant and leader from the Duke Undergraduate Academic Resource Center to present a workshop on time management tailored to meet the needs of the biomedical graduate student audience. A key difference between undergraduate and graduate time management needs is that undergraduates often struggle with juggling structured commitments, whereas graduate students have significantly less structured time and therefore must learn to effectively and productively organize their schedules. After the presentation, student attendees discussed individual strategies they use to stay organized and hold themselves accountable.

### Career preparation

Addressing career-related topics, the Assistant Director of the Duke Career Center delivered a tailored presentation covering CV/resume building, interviewing techniques, salary negotiation, and job search strategies. More specifically, the session leader conducted a dual-purpose presentation that began with

informational tips regarding CV and interviewing best practices, before proceeding to a "Q&A" style discussion. Interestingly, many of the student attendees during this session were closer to the beginning of their respective programs, with a large majority of the questions focusing on understanding how to leverage one's experiences for productive salary negotiations.

## Visualizing science

To promote best practices in data visualization and design, the committee chairs enlisted an award-winning senior BioCoRE scholar who works with science communication agencies in the local community. The workshop focused on creating visually appealing and accessible figures and presentations, offering real-time feedback on attendees' previous posters. The session leader focused on demonstrating the importance of tailoring poster presentations for several different audiences: from those most familiar with the attendees' research, to the public who may be unfamiliar with academic science. Additionally, the session included a discussion regarding information to include on academic posters to tell a coherent story–again, focusing on what stories would be most appropriate for different audiences. This session provided important information in data visualization and design, and in doing so, also demonstrated that "keeping one's audience in mind" was a key component in the development of soft skills and non-academic career preparation.

## Communicating science

In the final installment of the BUILD-U series, the professional development committee chairs invited a former Duke professor and current director of science engagement from a neighboring institution to lead a session on storytelling in science. The session leader focused on using scientific storytelling to communicate the importance and impact of science to funding agencies, taxpayers, and the public. Following tips on effective research communication, students worked on writing short abstracts and shared them with peers. As with previous sessions, the workshop format included time for attendees to ask specific questions after the presentation.

After each workshop, students gathered to provide feedback, anecdotally expressing satisfaction with the sessions. The workshops developed a core audience, with many students attending all or multiple sessions in the series. On average, each of the six workshops in the series attracted at least 20 attendees spanning from 1st to 5th year students.

## Workshop series outcomes

To assess the effectiveness of the BUILD-U series, the BioCoRE annual program survey was updated for the 2023–2024 academic year to include a Likert-scale question about the BUILD-U series. Participants were asked to rate the usefulness of the workshop series (1–5, from useless to highly useful, see Figure 4). Of the thirty-seven total respondents for this particular question in the updated survey (Supplementary Table 4), 12 (32%) did not participate in the BUILD-U program for this year, or responded N/A. Among the 2023–2024 workshop participants ($n = 25$, consistent with an

average of ∼20 attendees per workshop), 72% rated the workshop series as highly useful (five out of 5), 20% as somewhat useful (four out of five), and 8% as neutral (three out of five, neither useful nor useless). No ratings were below 3 out of 5. Like the 2023 survey (Figure 1), most respondents in 2024 were 1st-year students (Supplementary Figure 1).

## Discussion

Given the increasing demand for biomedical research trainees to develop interpersonal or "soft" skills to enhance their employability post-graduation, student support and development programs like BioCoRE should respond by focusing on supporting scholars as they transition into diverse career paths (Moreira et al., 2019; Schmidt et al., 2023; Chepp et al., 2022; Layton et al., 2016). To guide future iterations of the workshop series, respondents were again asked an open-ended question ∼2 months after the final BUILD-U workshop: "*What additional programs, services, and skills development should BioCoRE provide*?" This feedback will inform our thematic analysis for the program director and professional development committee, helping to shape workshop topics for the subsequent year. More specifically, the feedback will be categorized, and grouped into themes; and programming will be determined based on potential impact to students. Notably, some topics from previous years could not be included in the current six-installment series (e.g., publication processes, see Figure 3 and Supplementary Figure 2) due to time constraints. Topics from previous surveys may be archived and incorporated in future installments.

A new thematic analysis indicates ongoing student needs and concerns (Supplementary Figure 2), which we plan to address in the 2024–2025 BUILD-U series. Additionally, scholars were surveyed about changes in their career aspirations since entering graduate school, revealing minimal shifts (Supplementary Figure 3), as they continue to prepare for careers beyond academia. Furthermore, to improve the robustness and accuracy of our data set, we plan to consider alternative survey response incentive strategies (Saleh and Bista, 2017). Currently, the cohort with the highest response rate is rewarded with a cohort outing; however, junior cohorts (1st and 2nd year) typically account for over 50% of the survey responses. Targeted incentives for senior cohorts could shift the tenor of our thematic analyses toward topics such as networking, negotiating, and management skills.

It is important to highlight that the BioCoRE BUILD-U workshop series complements other forms of support in navigating the hidden curriculum for biomedical graduate research trainees at Duke University. For instance, 1st-year trainees in the School of Medicine engage with topics in the "Foundations of Professionalism" course within the umbrella BIOTRAIN curriculum required for all School of Medicine Ph. D. students, led by the Office of Biomedical Graduate Education (OBGE) staff, faculty, and student mentors. In addition to the BIOTRAIN courses, OBGE organizes professional development and wellness programing, such as leadership and management training and a series of recorded webinars on topics including reading scientific papers,

**What additional programs, services, and skills development should BioCoRE provide?**
**2022-2023 Responses:**

*"How to prepare post PhD/negotiations in salary and benefits"*

*"Science communication, public speaking, among others related to oral communication."*

*"In my opinion, career exploration is one of the most important things to take advantage of during graduate school"*

*"I would like to see more practical workshops: like what does the publication process look like?, how to keep track of the scientific literature that you read, how to solve [conflicts] with PIs or lab members, more mental health/mindfulness workshops"*

*"Soft skill workshops. I feel like there are sometimes things I still do not always get, even as a fourth year. Like how to best communicate with my PI, how to navigate applying to grants, etc. Maybe having a monthly soft skill chat with [the BioCoRE Program Director] and older graduate students would be helpful to discuss a different yet important soft skill each month"*

*"Since most graduate schools do not offer it, data visualization, presentation training, and poster/slide design workshops would be amazing. Science communication is becoming increasingly more and more important for our success as scientists, yet departmental organizations tend to provide little to no formal training in this regard."*
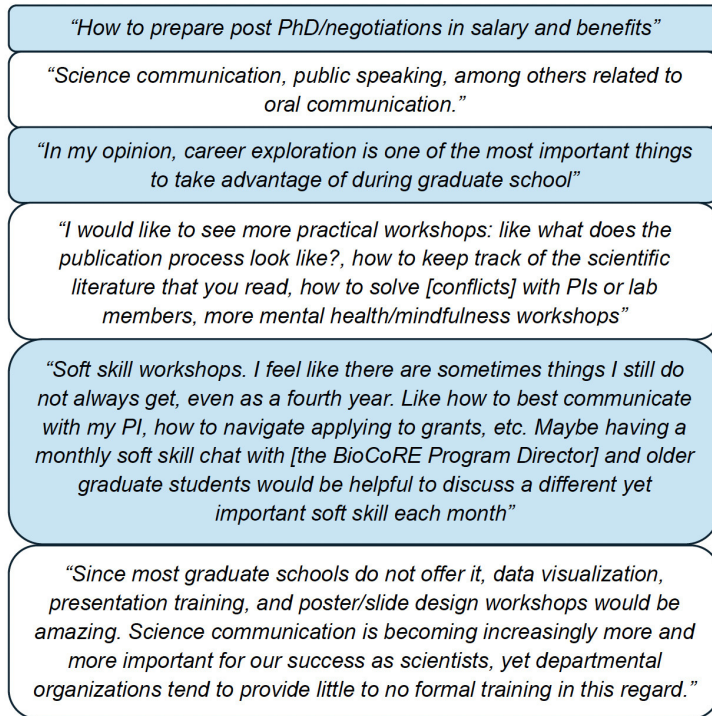
FIGURE 3
2023 speech bubble. Responses to the 2023 annual BioCoRE survey were analyzed by the program director and utilized to inform programming for the upcoming academic year.
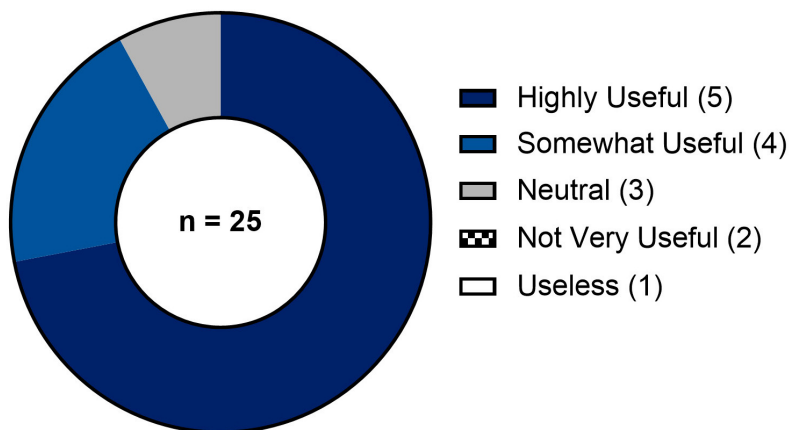


FIGURE 4
2024 BUILD-U workshop ratings. BUILD-U survey ratings from respondents; most students rated the workshop series as "highly useful" denoting the success of the workshop.

coping with stress, enhancing self-knowledge, and managing professional relationships.

Furthermore, all graduate students benefit from a series led by the Assistant Dean for Graduate Student Professional Development in the Graduate School, with webinars covering a wide array of topics including career planning, work-life balance, and networking. Besides the professional development series, the graduate school hosts six progress lunches throughout the summer where students can provide regular updates on their career development goals over a provided lunch. These events serve as an important opportunity for staff to help students overcome challenges by connecting them with on-campus resources. It should also be noted that some departments and the students within them have developed career development programs. For example, the

Department of Neurobiology at Duke hosts professionals from consulting, scientific editing, data science, and project management to name a few.

We encourage our BioCoRE scholars and the broader graduate student population to utilize all available resources, as we envision our workshop series as part of a synergistic model supported by the graduate school and OBGE. BioCoRE scholars also explore diverse career pathways through monthly seminars and networking events with industry, government, academic professionals, and alumni.

The BUILD-U workshop series is part of a robust ecosystem of resources and opportunities within the SoM and institution, but can be distinguished from other means of support in the following ways: (1) the series covers a broad spectrum of soft skills crucial in biomedical research through topics that extend beyond lab success and mentor engagement (2) a diverse range of experts is engaged to address scholars' specific needs; (3) an affirming space is provided for biomedical trainees from underrepresented backgrounds (see Supplementary Tables 1–3) to experientially uncover aspects of the hidden curriculum while developing various transferrable skills (4) workshops are designed to target students across all stages of training; and (5) the moderate size of the BioCoRE program allows feedback gathered through the annual survey to be considered, developed, and implemented quickly delivering timely responsiveness to scholar needs throughout the academic year. Currently, many professional development programs are focused on preparing post-baccalaureate and PhD trainees for the academy; however, even emerging programs, such as the "Navigating Academic Careers" pilot course at the University of Texas MD Anderson Cancer Center has programming dedicated to soft skills, as evident from modules that include "interviewing," "work-life balance," and "time management," highlighting just how integral and necessary soft skills are to the modern Ph. D. training experience (Perez-Oquendo et al., 2024).

To ensure the success of biomedical graduate research trainees in their career paths, it is essential for them to recognize that not all skills developed in academic disciplines are universally applicable. Gaining a broader perspective on the skills necessary for non-academic careers is crucial for graduate trainee preparedness and choice of career. By sharing our methods for uncovering the hidden curriculum with other institutions we aim to highlight the ways in which these types of programs and initiatives can be developed and refined to help facilitate their implementation.

Although Duke University—and BioCoRE by extension—is replete with resources and diverse personnel, we have demonstrated a cost-effective approach to help students develop their soft skills and employability leveraging internal personnel. In conclusion, given the rapidly evolving career landscape for biomedical research trainees, developing "soft" skills is increasingly critical for career success both outside of and within academia. Through the BUILD-U series, we describe an efficient approach to help trainees recognize and translate skills they may already possess and fortify others that are desirable to employers but may not be as easily developed in traditional STEM graduate education programs. The BUILD-U series draws on existing expertise from the university system to build a curriculum complementary to conventional graduate education. Data and student feedback gathered thus far indicates this series to be successful in meeting the stated objectives and we believe this model can be adapted to a variety of institutional environments and graduate training programs with great benefit for the next generation of leaders in the biomedical workforce.

## Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

## Ethics statement

The studies involving humans were approved by Duke University Health System Institutional Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

## Author contributions

DR: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. AL: Data curation, Investigation, Methodology, Visualization, Writing – review & editing. DN-W: Data curation, Investigation, Methodology, Visualization, Writing – review & editing. JF: Resources, Supervision, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2024.1473372/full#supplementary-material

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