Remote Learning Barriers and Opportunities for Graduate Student and Postdoctoral Learners in Career and Professional Skill Development: A Case Study[†]

Margery Evans Gardner, Elizabeth C. Bodiya, and Shoba Subramanian*

Office of Graduate and Postdoctoral Studies, University of Michigan Medical School, Ann Arbor, MI 48109

Career and professional development competencies are critical for biomedical PhD and postdoctoral training. In the current educational landscape, programs that meet these competencies are offered and attended in an ad hoc manner. During the COVID-19 pandemic and the accompanying switch to virtual learning, our team observed a surge in interest for our weekly nonsequential programs. In this study, we surveyed our learners to better understand motivators for attending these programs during the pandemic and to identify barriers for participating in such events before and during Work-from-Home. Our data indicate that conflict with research responsibilities, time spent to get to the event location, and planning time to attend are all significant barriers to engagement. Notably, feelings of being overwhelmed, which increased slightly during the pandemic, stood out as an identified barrier. Per our results, the virtual format was an attraction. While 58% of respondents would prefer to access professional development programs virtually in the future, almost 42% indicated a preference for in-person events when normalcy resumes, as the physical presence of an instructor and of peers result in a deeper engagement. Our collective analysis here suggests that learners will benefit from a hybrid or combination of synchronous and asynchronous career and professional development programming in the future, even postpandemic, to reduce identified barriers. Alongside hybrid learning engagements, we strongly recommend structured time for learners to enhance their professional competencies, enabled by a commitment from departments and faculty mentors to bring equity in professional skill building and foster a life-long growth mindset.

INTRODUCTION:

Our team supports the Career and Professional Development (CPD) of the ~1,200 graduate and postdoctoral learners at the University of Michigan (UM) Medical School. We provide a variety of programs ranging from weekly workshops to structured, time-limited, cohort-based programs. These evidence-based programs, which follow published recommendations (1–4), are aimed at driving professional, academic, and career success and cover a gamut of topics, including career exploration, transferable skill building, job application best practices, and portfolio building. While our programs are extracurricular and not required to meet degree requirements, participating learners find significant value in them, as seen in our report with 2019 CPD Highlights (5).

Most universities across the United States shut down in March 2020 due to the rapidly increasing COVID-19 cases. Leadership units at research-intensive universities focused on two main items: (i) pivoting credit-bearing curricular courses to online formats with some structural support and (ii) developing and implementing procedures for prioritizing critical research activities and enabling a rapid research ramp-down (6).

Beyond the early years of PhD training, there is seldom any requirement for course-based learning for PhD and postdoctoral learners. Instead, biomedical PhD students and postdoctoral fellows spend most of their working hours in their training laboratories conducting inquiry-based research. Thus, the research ramp-down along with the lack of structured learning requirements, created a lot of undefined time and space for these learners. While faculty used their discretion to provide some structure to learners' research through remote data analysis, writing manuscripts and grant proposals, this likely varied between labs and advisors.

In our state of Michigan, the "Stay Safe, Stay Home" mandate alongside that from UM in mid-March began a

*Corresponding author. Mailing address: Office of Graduate and Postdoctoral Studies, University of Michigan Medical School, 1135 Catherine St., Ann Arbor, MI 48109. Phone: 734-615-6511. E-mail: shobas@umich.edu.

period of time hereafter referred to as Work-from-Home (WFH). Until WFH, our offerings had been exclusively in-person. We rapidly reimagined our programs to enable remote learning. Through virtual programs, we continued to meet our learners' needs. Additionally, we created new programs covering many aspects of written and visual science communication to meet the likely demand for these skills during WFH and to guide learners' time in a purposeful way. Peer units on our campus and across the country also pivoted CPD programs to remote formats.

Upon launching our remote offerings, we observed a dramatic increase in RSVP numbers compared to when our programs were in-person. We hypothesized that with limited in-person demands, more learners would access our remote CPD programming. While we saw an overall doubling in RSVPs, the percentage of RSVPs who actually attended showed a mild decrease. Therefore, some barriers may have been alleviated with remote opportunities; however, others remained, and new barriers likely emerged.

In order to understand motivators for remote attendance and to pinpoint specific barriers in participation before and during WFH, we conducted a systematic survey. In this article, we share key findings of this survey. These findings and our evidence-based recommendations that stem from them inform future practices for CPD programming, helpful to peer institutions across the country. We believe that these recommendations, which can easily be implemented with limited budgets, enable flexibility, inclusion, and equity for diverse learners to access critical programs more effectively and efficiently.

METHODS

CPD marketing and communication

All events were marketed via email using the Mailchimp platform. UM Medical School graduate students and postdoctoral fellows are added to the email list during onboarding. Additional subscribers outside the Medical School are allowed to opt in. The list consists of graduate students, postdocs, and faculty and staff, university-wide. The total number of recipients varies as appointments change or as individuals opt-in/out of receiving email communications. Individual event announcements were sent ~1 week prior to the event. Communications were sent at the same frequency before and during WFH. Events were also marketed in a weekly newsletter and listed on our website. Learners could RSVP via the individual event announcements, newsletter, or the website.

RSVP and attendance data collection and analysis

RSVP here refers to the number of people who signed up and therefore expressed interest in participating. Atten-

dance correlates to people who actually show up for that particular offering. RSVPs were collected digitally using either Google Forms or Sessions-at-Michigan (an internal event management tool developed by the UM Office of the Vice President for Student Life). During registration, learners were asked to indicate their stage of training, and program name and were asked to submit a question or topic they wished to see addressed during the given event. During earlier CPD offerings, attendance was collected manually using a paper sign-in sheet. The Sessions-at-Michigan platform allows for digital attendance collection via an Apple iPad. Attendance to virtual events was collected using the Sessions-at-Michigan Self-Check-In feature using a shortened-URL or QR-code. Staff members also cross-referenced the virtual attendee list with the Sessions-at-Michigan registration to log attendance. All registration and attendance data in this study were collected using the method described above with one event facilitated by an outside vendor as the only exception. Statistical significance was established comparing before and during WFH RSVP and attendance rates each using a 2-tailed unpaired Student's t test.

Survey Design and Analysis

We created a short survey that aimed to identify the primary motivators that encouraged increased participation during WFH and to understand the barriers for CPD event participation before and during WFH. The survey contained specific questions related to how learners engaged in CPD activities before and during the WFH. The survey also included queries future programming preferences. For all survey questions, please see Appendix 1.

The survey created using the UM Qualtrics XM survey platform for this study is under IRB exemption (#HUM00187729) from the UM Office of Research. An electronic link to the anonymous survey with informed consent was distributed to PhD and Master's students, post-baccalaureate scholars, and postdocs (approximately 1,200 learners) within the Medical School via email using an internal listserv and was active for 8 to 9 days. We received 249 responses representing approximately 20% of the current learner population.

Questions that probed on motivators to participation before and during WFH were scored on a four-point scale: not a factor, somewhat of a factor, strong factor, or N/A (not applicable). The data presented here represent all "somewhat of a factor" and "strong factor" responses. Respondents selected whether each barrier to participation was a factor, while indicating if it was present both before and during WFH. To assist in future planning, learners were asked if they would prefer to engage in in-person or virtual activities and their motivations for either. The survey concluded with several optional demographic questions: stage of training, years in current position, gender identity, underrepresented minority, and nationality.

RESULTS

At the Office of Graduate and Postdoctoral Studies, we offer weekly programs for CPD tailored for our graduate and postdoctoral learners. Since the WFH mandate was announced at UM, we carefully pivoted all our programs to remote formats primarily using video conferencing software such as BlueJeans and Zoom. During this mandate, we observed changes in RSVP and attendance numbers for similar weekly, non-cohort-based programs compared to before WFH (Fig. 1A). There was an increase in RSVP with an average 42 RSVPs/event before WFH and 82 RSVPs/event during WFH (Fig. 1A). Interestingly, although the average attendance, calculated as a percentage of those who RSVPed, per event went down slightly (50% pre-WFH to 40% during WFH), it was not a statistically significant decrease (Fig. 1A). Additionally, we piloted a couple of science communication workshops at the beginning of WFH, which had 300
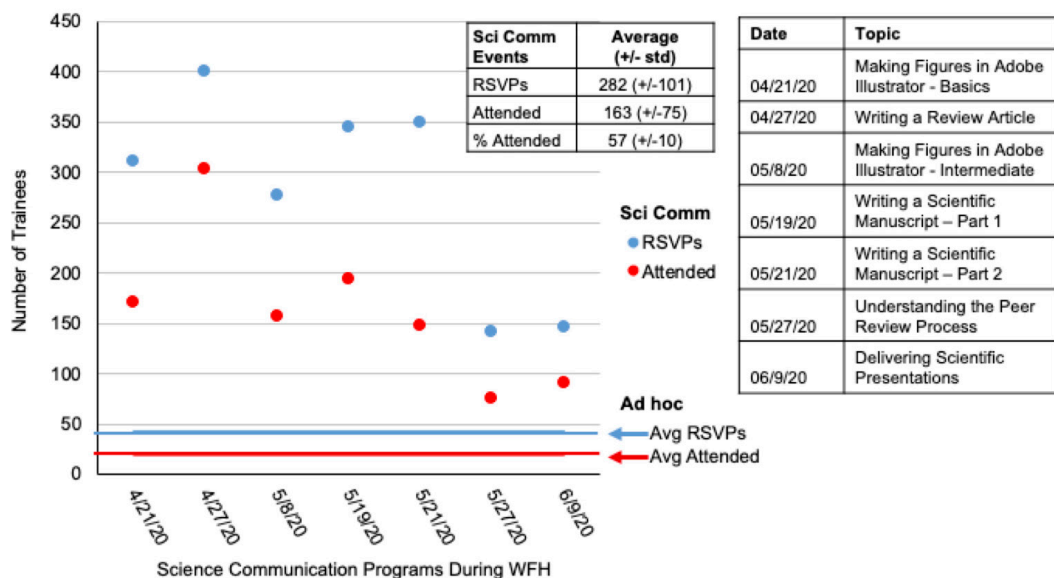
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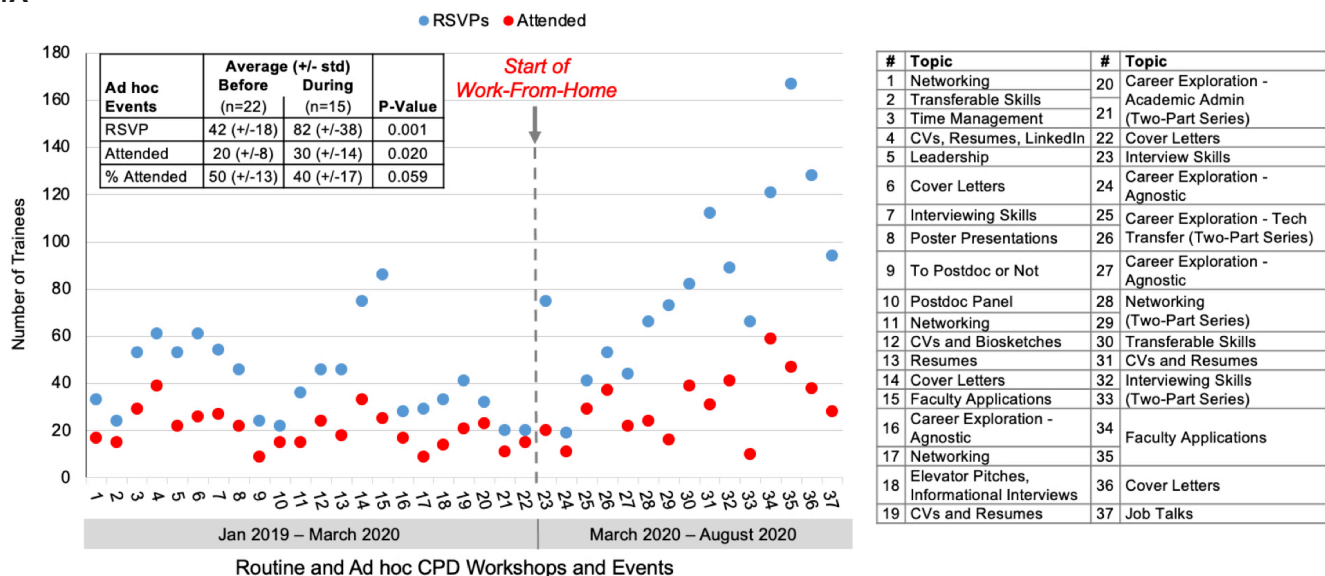
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FIGURE 1. Interest and attendance increased in remote CPD programming. (A) Learner RSVPs (blue) and attendance (red) for routine, ad hoc CPD. Transition from in-person to virtual programming at the start of WFH is indicated by the gray arrow and dotted line. Program RSVPs and actual attendance numbers were collected for all in-person and virtual programs before and during WFH. Shown are averages ± standard deviations. *P* values were calculated using a two-tailed unpaired *t* test. Event names for corresponding *x*-axis numbers are found in the corresponding list table. (B) Learner RSVPs (blue circles) and actual attendance (red circles) for science communication programming during WFH, compared to the average RSVP rate for regular, ad hoc events (blue line), and actual attendance (red line). Average RSVPs, actual attendance, and the percentages of RSVPs who attended are reported in the inset. Event names for corresponding *x*-axis WFH dates are found in the corresponding list table.

to 400 RSVPs/event. Based on this significant interest, we conducted a needs assessment check-in to understand this considerable uptick. We identified manuscript writing, peer review, and scientific speaking as further topics of interest. Across all science communication events, we observed an average of 282 RSVPs/event; of those who RSVPed, 57% attended across all science communication topics offered (Fig. 1B). Based on this increased interest in participation during WFH (mid-March through August 2020), we were curious to identify the primary motivators and barriers for CPD events before and during WFH, so that we and others can plan our future CPD programming more effectively.

To understand these, first we asked whether the frequency of the respondent's engagement in CPD programs increased during WFH (Fig. 2). Fifty percent of postdocs indicated that they had increased their frequency of CPD participation during WFH, whereas about 4% were unsure. In the case of Masters and PhD students, fewer respondents said that they had an increase in the frequency of attending CPD programs during WFH compared to those that did not. Overall, however, 34% of our respondents indicated that they attended more professional development events during WFH and remote learning.
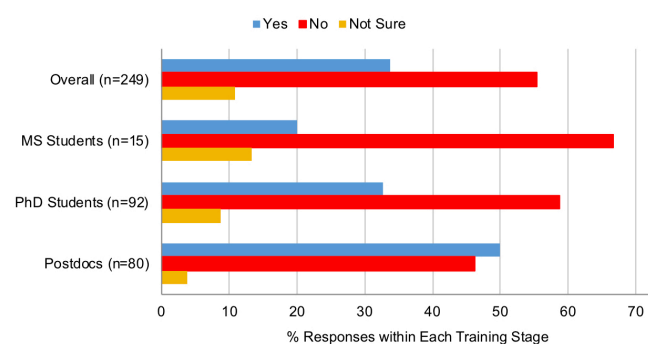
FIGURE 2. Learner-perceived frequency of attendance in CPD programming during remote learning and WFH. Responses divided by learner stage and presented as a percentage of the total responses within the respective training stage. Learners reported their perceived attendance frequency in CPD programs during in-person learning and virtual WFH learning. Learners responded "yes" to increased participation in CPD programming (blue), "no" if their participation did not increase (red) or if they were "not sure" (yellow).

Next, we wanted to understand what the motivators were for learners to attend remote events during WFH. This question was filtered to include only respondents who answered "yes" or "not sure" to whether their participation increased during WFH. As seen in Figure 3A, approximately 125 respondents selected either virtual format or schedule flexibility during WFH as a strong or somewhat of a factor for attendance. Not surprisingly, interest in science communication events obtained the third highest selections, which is corroborated by the initial needs-assessment survey for new programs during WFH. This was followed by increased awareness of events as a motivator. Pressure to go on the job

market and encouragement from PI (principal investigator or research advisor) were ranked below these other factors but still received a significant number of responses (Fig. 3A).

Beyond the motivators for learner participation in remote events, we sought to understand the barriers that impacted learner participation before and during WFH. Across nine barriers listed in the survey, with an additional "other" category, learners were asked if each barrier impacted their ability to participate in CPD activities before WFH, during WFH, or neither. Before WFH, transportation/location of events, conflict with date/time, and conflict with research responsibilities were significant barriers to participation, with the top barrier impacting close to half of the respondents (Fig. 3B). Our data show a reduction in each of these barriers during WFH. On the other hand, feeling overwhelmed more than doubled, caring for dependents went up 5-fold, and lack of stable internet went up 16-fold as barriers during WFH. Personal conflicts, awareness of programs, and PI support to attend events remained mostly similar before and during WFH.
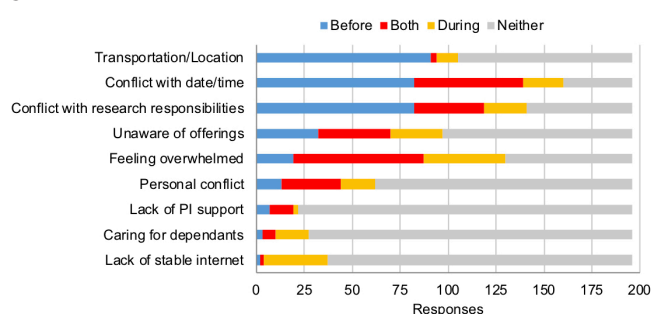
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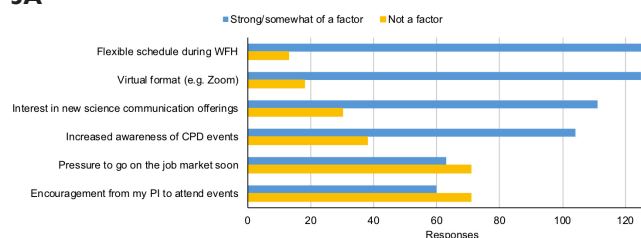
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FIGURE 3. Primary motivators and barriers for participation in CPD programming before and during WFH. (A) Motivators for participation during WFH. Trainee responses (n = 145; x-axis) on the level of influence by each of seven motivators (y-axis) on participation are shown. Respondents could indicate whether each motivator was "strong factor" in participation, "somewhat of a factor," "not a factor," or "not applicable." Respondents who selected motivators as a "strong factor" or "somewhat of a factor" in participation were pooled. Respondents who identified motivators as "not applicable" are not shown. (B) Barriers before and during WFH. Trainee responses to whether nine barriers (y-axis) were a factor in their ability to participate in CPD activities before WFH (blue), during WFH (yellow), both before and during WFH (red), or not a factor during either time period (gray). Total responses for each selection are reported (x-axis).

Based on our findings that several barriers to participate in CPD programming differ before and during WFH, we asked whether there is a relationship between the top barriers before WFH and the top motivator of schedule flexibility for attending virtual events during WFH. As seen in Figure 4, the top motivating factors (flexibility of schedule and virtual format during WFH) related very strongly with a decrease in the top three barriers that are identified between before WFH and during WFH (including respondents who chose both time periods): date and time conflict, research responsibilities, and transportation to the event location.

Barriers:	Unfiltered	%Change	
		Filtered by Motivator:	
		Flexibility of Schedule	Virtual Format
Conflict with date/time	-44%	-52%	-47%
Conflict with research responsibilities	-50%	-64%	-66%
Transportation/Location	-85%	-93%	-93%
Caring for dependants	140%	100%	143%
Lack of stable internet	775%	733%	767%

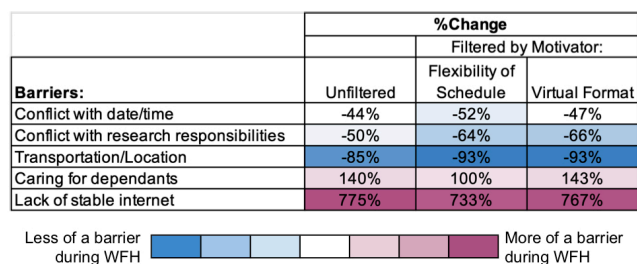Less of a barrier during WFH   More of a barrier during WFH

FIGURE 4. Relationship between barriers and primary motivators. Responses to three barriers that decreased during WFH and two barriers that increased during WFH were filtered to only include those who indicated that increased flexibility of schedule or virtual format during WFH was a motivator to attending virtual CPD programming

Besides understanding the recent motivations and barriers in CPD participation, we also asked our learners about their preferences for the format of future programming. Our survey asked learners if they would prefer to mostly engage in remote or in-person events, when in-person events are a safe option. Across learner groups, 58% of respondents indicated a preference for remote events, while 42% selected a preference for a return to in-person programs, as highlighted in Table 1. Trends per learner group closely followed the same preference. Respondents who selected remote/virtual programming for the future (n = 108) were asked for their top three reasons driving this preference. Figure 5A shows that 77% noted that they would not lose time on cross-campus transportation by attending virtual programming. Other top reasons included the ability to watch recorded sessions afterward (62%) and that remote options helped learners prioritize CPD (58%). Almost half of respondents, 48%, indicated that they learn equally as well or better in remote situations. Of those who would prefer future remote programming, 31% indicated a higher level of comfortability when engaging virtually. Lower factors in virtual preference included learners utilization of inclusive teaching features (e.g., closed-captioning) in remote learning (19%) and learners who juggle caregiving duties (8%). Write-in answers further emphasized location and distance, with some learners living outside of Ann Arbor, thus remote options would be more accessible to them.

Figure 5B displays why 42% of learners prefer a return to in-person CPD. 76% indicated that the physical presence of an instructor improved learning. Other top reasons referenced the challenge of staying focused when attending a remote session (67%) and a desire for social interaction (65%). Over 40% of those preferring in-person sessions shared that they prioritize in-person activities more than remote options, and in conjunction, in-person programs encourage the physical requirement to leave the lab and work for a short time (42%). To a lesser degree, 27% of those that favor future in-person events prefer an environment that resembles a physical classroom, including the presence of peers.

DISCUSSION

Career and professional development (CPD) training of graduate and postdoctoral learners is pivotal in the changing landscape of career outcomes (7, 8). Targeted transferable skill building and active career planning is key for future workforce development (9). Significant strides have been made across several institutions and federal funding agencies to prioritize quality and quantity of CPD programs (10). These programs are typically offered by several offices ranging from graduate schools, college-level graduate and postdoctoral training offices, as well as departmental units.

TABLE 1.
Learner preference for future CPD programming.

	I would prefer to engage in			
	remote events most of the time	n	in-person events most of the time	n
All trainees	58.1%	108	41.9%	78
MS students	60.0%	9	40.0%	6
PhD students	57.1%	52	42.9%	39
Postdocs	58.8%	47	41.3%	33

Learners' responses (n = 186) on preference for future CPD program format in either remote or in-person events. Responses are separated by training stage.
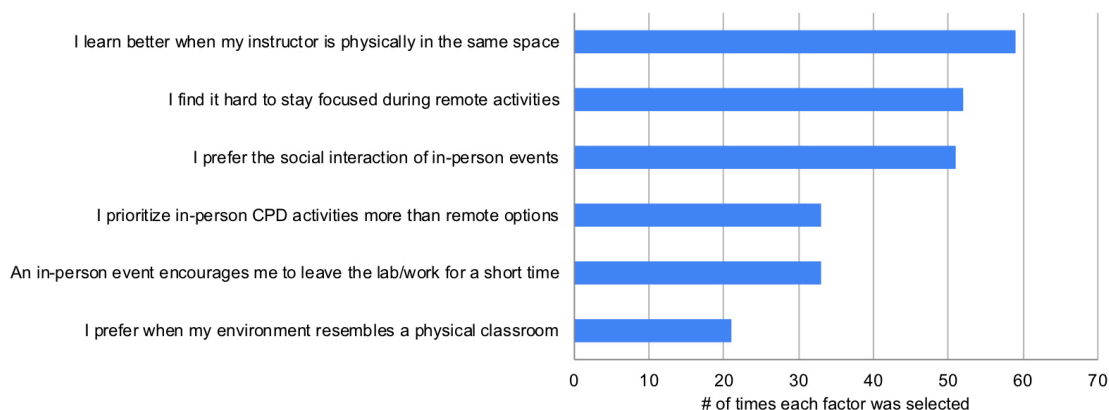
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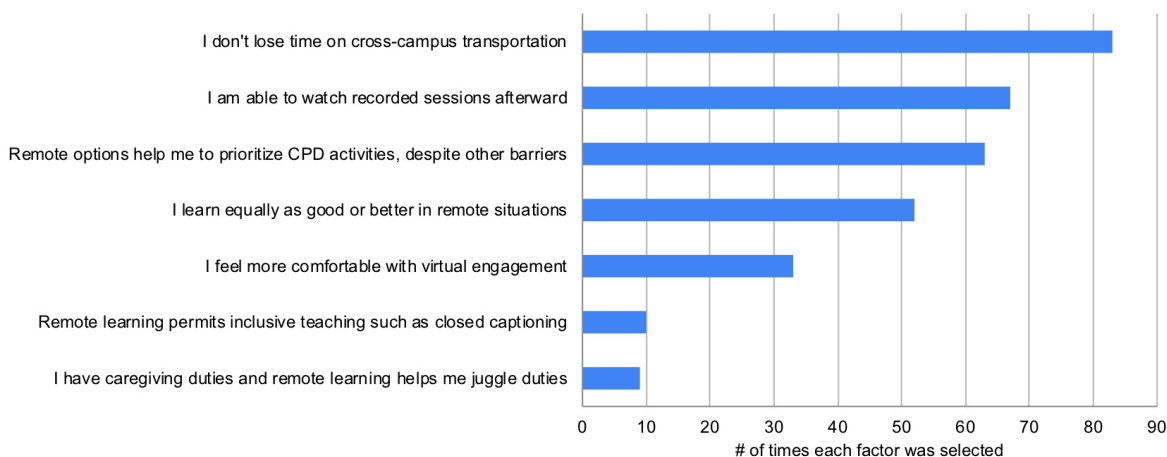
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FIGURE 5. Learner preference and reasoning for preferred format of future CPD programming. (A) Learners who prefer future remote CPD programming (n = 108) chose the top three reasons among seven choices (y-axis) for their preference. Reported are the number of times each reason was selected (x-axis). (B) Learners who prefer future in-person CPD programming (n = 78) chose the top three reasons among six choices (y-axis) for their preference. Reported are the number of times each reason was selected (x-axis).

Despite the advances, most training programs do not require CPD program participation toward meeting required milestones in education. This in turn meant that when the pandemic-driven shut down of research and associated WFH mandate was put in place, it was left up to the individual units how they wanted to continue with their career and professional development programming.

Our team regularly communicates with learners to understand needs and accordingly adapts CPD programming to meet them. Therefore, tailoring programs at the beginning of remote learning was not an unprecedented move on our part, as it was primarily based on learner feedback. However, the significant spike in RSVP for both our routine events and science communication workshops was rather surprising. Based on this increase in interest and learner feedback, it was clear that learners found high value in these programs. We further believe that they used our space to find purpose during a time when everything else was mostly undefined.

Interestingly, although there was an increase in RSVP per event during remote learning as compared to before, fewer than 50% of the survey respondents said that they increased their frequency of participation. This can be explained either by the possibility that (i) we attracted many of the same learners who in the past attended our program or (ii) it alludes to a bias in who responded to the survey, or (iii) it points at a likely misalignment in learner perception. Such a misalignment can be attributed to the fact that learners may not have the necessary calibration to compare a before/after timepoint, since CPD is not curricular and is accessed in an ad hoc manner.

In this study, we note that rising RSVPs did not necessarily lead to equally high attendance numbers, a typical trend in our event statistics both before and during WFH. To reduce the gap between RSVP and attendance rate, we complement our routine and ad hoc programming with cohort-based, structured, sequential programs. During these sequential CPD programs, we see a significantly higher attendance rate. For example, an eight-module program titled You[3]: Postdoc Leadership and Management Program had an attendance rate of nearly 95% in 2019 (11). Since CPD attendance is not mandatory for degree or program requirements for MS and PhD, learners must hold themselves personally accountable to pursue career and professional development. Our future goals include adding

CPD competencies as a curricular requirement, providing alignment and accountability.

From the survey responses we gathered, it was unequivocal that major barriers exist for learners in planning these events into their daily schedules. These barriers are exacerbated in large institutions like ours, where labs are spread out as far as 3 miles away, and transportation/parking are limited, effects of which could be amplified in the winter months. Interestingly, almost the same number of respondents selected transportation/location as a barrier before WFH as those who indicated it was not a barrier during either time. This suggests that learners from labs proximal to routine program venues are able to attend more easily than others. While the location issue could theoretically be solved by offering programs in multiple locations, in many campuses access to reserving classroom spaces to meet capacity and other requirements are often a huge premium. Additionally, some event spaces require an internal fee. Learner access to parking continues to be a huge limitation, making it equally difficult for learners who are able to use their own vehicles to commute to the events. Finally, like many of our peer institutions, our CPD programming is supported by a small staff with limited capacity to run events in multiple locations. These barriers collectively drive systemic inequities in learners' ability to access in-person programs.

Conflict with research responsibilities was indicated as a major barrier to attending CPD events before and, to a lesser extent, during WFH. This conflict, at some level, is at odds with national recommendations from the National Academies of Science, Engineering, and Medicine (12, 13), the Council for Graduate Schools (3), and the National Postdoc Association's Core Competencies (https://www.nationalpostdoc.org/page/CoreCompetencies), all of which strongly suggest that CPD programs be integral to learning in order to build skills for developing future workforce. While those learners who are on federal training grants make targeted plans for CPD requirements to meet their funding expectations, the intentional planning or participation mandates are not the same for others. Thus, without changes in programmatic elements and infrastructural support, the barriers to balance research with CPD program engagement will continue to limit the holistic development of graduate and postdoctoral learners. Our findings also set the groundwork for future studies to look at the role of trainee background and identities on accessing CPD programs. For example, it is already known that the "hidden curriculum", where expectations that are not overtly communicated, particularly affects learners new to (American) higher education systems (14) as well as those who are first-generation college degree holders (15).

We believe that creating learner-centered guidelines to engage in professional development activities beyond coursework and research can bring more equity in access. An intentional professional development curriculum, including clear expectations for competency development and protected time, will not only drive success in a learner's future career but will also enhance academic success and outcomes in their training years. Creating clear expectations for PhD career and professional development was also reported as a main action item in a recent multi-stakeholder national meeting addressing these challenges (16).

Science communication training including the core areas of written communication including manuscript writing, creating figures, peer review best practices occurs within the research labs with ad hoc guidance by PIs or senior lab members. The unprecedented interest and attendance we had for these events indicates that the historical apprenticeship-based training where communication skill building and feedback is primarily dependent on advisors or labs is not sufficient. Our data indicate that this is an area of immediate and high need that should be formalized into the training journeys of both graduate and postdoctoral learners.

As we plan for a future when returning fully to in-person work is not a barrier, we find that the split between learners who prefer remote learning as compared to in-person is small. Importantly, the reasons picked for either preference align with their personal motivations and barriers. Moreover, these data shed light on other systemic issues. For example, postdoctoral fellows place higher weight on the physical instructor presence and on peer social interaction when they indicate an in-person preference. This aligns with postdoctoral training years being isolating for many learners (17, 18).

TABLE 2.
Future recommendations for career
and professional development programs.

Purpose	Action Item(s)
Maximize learner engagement with flexible and accessible programming.	• Provide a blended form of in-person and remote learning as the norm toward equity.
Empower learners to plan CPD as a central goal for training success with institutional support.	• Activate tailored plans for transferable skill-building and career exploration. • Provide protected time to attend CPD events to bring plans to fruition.
Be inclusive of learners with diverse abilities and access to resources.	• Record, caption, and archive programs for learners unable to attend in real-time.
Create structured interactions when programming is offered virtually.	• Communicate learning goals in advance and indicate whether video or in-person participation is expected so learners can be prepared.

To serve as guidelines for practitioners, administrators, and institutions toward enabling flexible, inclusive, equitable, and engaging Career and Professional Development (CPD) programs for graduate and postdoctoral learners.

As we consider more remote or hybrid programs, it is important to consider previously published barriers in online learning. Based on studies conducted in Massive Open Online Courses (MOOCs) (19, 20), the main barriers include balancing family and work during online learning and the influences of past online learning experiences on future online participation (19, 20). Thus, we believe that remote programming should be of high quality and should be offered without directly impinging on work-life balance if we want to maximize engagement and outcomes.

In the future, we recommend institutional infrastructures for graduate and postdoctoral CPD learning to be flexible, accessible, and inclusive, as shown in Table 2, to complement other published recommendations (21). Ultimately, CPD can be easily adapted for remote learning compared to other aspects of biomedical training. Despite this, it has not been at the forefront of learning goals for advanced STEM learners. Herein, based on our experiences delivering remote programs during a pandemic, we have uncovered new barriers as well as corroborated previously known issues. Based on learner voices, we use this opportunity to provide institutional recommendations toward making CPD more accessible to all learners.

Finally, the barrier of "feeling overwhelmed" was unambiguous, in learners reporting this feeling before and during WFH. Such feelings among graduate students have been discussed in another recent study during the pandemic (22). Although this feeling can easily be attributed to the overall mood of 2020, which has been beset with multiple calamities converging at once, learners need dedicated and proactive support in mental health and well-being at every stage of their training and under all circumstances (23), so they can show up to engage fully. Our recommendations to maximize CPD planning into the daily lives of busy learners, if turned into action, may at least alleviate anxieties around career prospects and build confidence in our future leaders.

SUPPLEMENTAL MATERIALS

Appendix 1: Survey questions
Appendix 2: Supplemental data

ACKNOWLEDGMENTS

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