EDITORIAL

Moving student research forward during the COVID-19 pandemic

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Elmer SJ, Durocher JJ. Moving student research forward during the COVID-19 pandemic. Adv Physiol Educ 44: 741–743, 2020; doi:10.1152/advan.00153.2020.—The COVID–19 pandemic has impacted undergraduate and graduate student research. With the uncertainty right now, it is a challenge for faculty to offer clear guidance for how students can proceed with their research and capstone projects. In this brief editorial, we offer suggestions for moving student research forward during the COVID-19 pandemic.

COVID-19: graduate education; physiology education; undergraduate research

IMPACT OF COVID-19 PANDEMIC

COVID-19 poses a major health threat and has altered our lives in many ways. In higher education, students, faculty, and staff are adjusting to new strategies for conducting research. Many research groups have adapted to perform work remotely, while others have returned to the laboratory on a limited basis. However, some groups, such as those performing human subject research with clinical populations, have been unable to resume normal research activity. Recent data from The College Crisis Initiative dashboard (16) indicated that only one-quarter of the ~3,000 U.S. colleges and universities planned to reopen their campuses this fall primarily or entirely in person. Thus, facilitation of research will be a challenge for the foreseeable future, and investigators should be prepared to respond in the event of a pause and/or shutdown (13).

Currently, many students are concerned as to how they will complete their research. Indeed, a recent survey by the American Physiological Society (4) revealed that 58% of trainee respondents said that laboratory closures due to the COVID-19 pandemic may increase the time it takes them to complete their training. Many faculty advisors have echoed similar concerns and, despite input from their university, research office, and/or graduate school, are struggling to provide clear guidance for their students. The objective of this editorial is to offer suggestions for moving undergraduate and graduate student research forward during the COVID-19 pandemic.

DEVELOP A PLAN

An important first step is for students and faculty advisors to engage in thoughtful discussion on how the COVID-19 pandemic has impacted the original planned research. As outlined below, we suggest discussing several key questions to help develop a revised plan.

Question 1: When does scientific research go exactly as planned? Rarely ever. Most research grant proposals even require the applicant to identify “unanticipated challenges” that could arise and “alternative solutions” for circumventing such challenges. Thus, planning ahead, confronting challenges, and persevering are part of the normal scientific process. Framing this question may help to lighten the mood and instill optimism for moving student research forward.

Question 2: A series of questions to ask relating to the original planned research include the following: 1) Can the original research question still be addressed? 2) Are the hypotheses still testable? 3) Can the experiments be carried out safely? 4) Could modifications be made to the experiments to improve safety in regard to COVID-19, and 5) Will the research be completed if there are future COVID-19-related interruptions? On the basis of the answers to these questions, it is important to explore whether the original research question and hypotheses can still be addressed by “adapting the methodology” to fit within the constraints of COVID-19. For example, could data be obtained from the literature, an online database, or preliminary data already collected? Alternatively, “refining the question and hypotheses” to better align with methodology suitable during COVID-19 may offer a better approach.

Question 3: How does COVID-19 impact time to degree completion? Students and faculty advisors should revisit degree program requirements to determine the best strategy for students to manage their time effectively and work toward achieving the next most relevant milestone for degree completion. For example, graduate students might shift their immediate focus to completing their coursework, preparing to take their qualifying examinations, and/or writing introductory parts of their thesis or dissertation as the COVID-19 pandemic plays out.

TACTICS FOR FACILITATING STUDENT RESEARCH

Early in the COVID-19 pandemic, international bioscience educators developed resources (8, 15) for facilitating undergraduate student research and capstone experiences remotely and/or online. Now that the COVID-19 pandemic has surpassed six months, we extend upon these resources to offer a list of tactics for undergraduate and graduate students and faculty advisors to consider for moving student research forward. We offer additional examples for those students engaging in capstone-focused projects as well.
Research-Focused Projects

- Systematic review and meta-analysis. Students can extend upon their literature searches and conduct a systematic review and meta-analysis. This can facilitate an even more focused question, without the need for laboratory data collection, to provide new higher-level evidence. It is important for students to consider support from their library and guidance from a biostatistician with this type of work.

- Focused literature review. Another review option for students is to adapt their review of literature chapter for submission to a peer-reviewed journal. For example, during the COVID-19 pandemic, the American Physiological Society announced a call for submission of mini-reviews to their journals (3) and encouraged trainees to participate. These types of reviews would require students to produce a concise summary of a research topic that has not yet been reviewed or on an emerging research topic.

- Innovative methodology or technical note. For students working on projects with innovative methods, the focus could be shifted to describe how these new methods will facilitate recording and measurement of data and improved understanding of physiology. Many of the American Physiological Society journals, such as the *Journal of Applied Physiology*, publish these types of articles (2). This type of publication could offer students important training for writing replicable methods and creating conceptual diagrams.

- Analysis of previously collected data. Students can revisit previous experiments and ask follow-up questions such as how do sex and/or age impact physiology. Such questions and post hoc analyses would create opportunities to test new hypotheses and use existing data as preliminary data per se. Moreover, exploration of sex as a biological variable, for example, is highly relevant, as the National Institutes of Health (17) expects this to be factored into research designs, analyses, and reporting for both animal and human studies.

- Mathematical modeling and computer simulation. Students could use existing data for development of mathematical models and simulations to describe and predict aspects of physiology. For example, mathematical modeling can be performed with software such as Excel or MATLAB and applied to principles ranging from molecular/cellular mechanisms to whole body human athletic performance. Students may need consultation from an additional faculty member with expertise in this area. We have secured those experts, for example, in other departments or colleges such as Mathematics, Physics, and Engineering.

- Data mining. Students could access online databases for discovery of novel patterns from large amounts of data. Specifically, data from genomic and protein sequences, DNA microarrays, protein interactions, biomedical images, electronic health records, or public health departments could allow students to identify patterns, predict outcomes, and infer hypotheses for future investigation. The open access resource developed by Lewis (9) offers a starting point for accessing publicly available data sets from around the world. As stated previously, students may need to recruit an additional faculty member with expertise in this area to offer guidance and serve on the committee.

- Limited contact/remote human subject research. Some studies involving human subjects could be conducted through noninvasive technologies, questionnaires, or some combination. Students might be able to collect data on a smaller sample of participants, a single participant for a case study, facilitate a home-based intervention, or assess participant responses through questionnaires and noninvasive devices, such as accelerometers. Students and faculty will need to work with their Institutional Review Board to obtain approval and/or make an amendment to a previously approved protocol.

- Grant proposal. Students could follow the requirements for an external grant proposal such as National Science Foundation Graduate Research Fellowship (11) or National Institutes of Health Pre- or Post-doctoral Fellowship (18) and prepare the application. Other options include professional organization and foundation-based grants and awards targeted for undergraduate and graduate students, post-doctoral fellows, and early career faculty (e.g., American Physiological Society, American Heart Association, American College of Sports Medicine, and National Strength and Conditioning Association). Given the current funding climate, this can provide great training, especially for those graduate students planning to go onto a post-doctoral fellowship and tenure-track faculty position.

Capstone-Focused Projects

- Outreach and public engagement. An important part of conducting research is being able to communicate scientific information to public audiences. Students could aim to disseminate their project through forums, including physiology (7) or teaching (10) blogs, podcast, or local newspaper. Another option is to develop an infographic to communicate key information in a more engaging manner.

- Aligning scholarly activity with COVID-19. If possible, students could adapt their project to address aspects of COVID-19 and how it impacts health, as described in recent commentary (12) and call to actions (5). Another possibility is for students to shift their focus in general and find a way contribute to the response to COVID-19. For example, students at our university are assisting with COVID-19 testing and contact tracing. Importantly, these students are performing a critical service to the campus and the local community, as without their assistance, testing and contact tracing would not be sustainable.

- Historical perspective. A creative avenue for students to explore is to highlight the history of a specific aspect of physiology or a physiologist. There are numerous historical papers (e.g., 14) published in *Advances in Physiology Education*. Moreover, this can serve as an opportunity to...
acknowledge historical achievements from traditionally underrepresented groups, which would support efforts to promote diversity and inclusion.

MOVING STUDENT RESEARCH FORWARD

Students and faculty need to work together to identify the best options for facilitating robust student research experiences during the COVID-19 pandemic. Collectively, the current editorial along with earlier resources and commentary (4, 8, 12, 15) provide a useful starting point for 1) discussing the impact of the COVID-19 pandemic on research, and 2) developing a plan for how to proceed with undergraduate and graduate student projects. For specific guidance on implementation with many of the suggestions listed above, we refer the reader to the resources developed recently by Lewis (8, 15). Specifically, these excellent resources offer a “how to” guide to facilitate and assess team-based research and capstone experiences for undergraduate students and also have implications for individual undergraduate and graduate student research projects.

We acknowledge that some of the tactics for moving research forward may fall outside the knowledge of the faculty advisor and/or committee. Therefore, it is important to recruit additional expertise to help guide the student as needed. Some of the research outputs that emerge from these suggestions may potentially be included as a part of a final year undergraduate project, master’s thesis, or doctoral dissertation. It is important to note that research requirements for such degrees can vary based on academic disciplines, universities, accreditation standards, and national educational systems. Therefore, any modification to these requirements should be discussed thoroughly among the student, faculty advisor, and committee; with approval following from the program director and/or department chair. The suggestions and tactics described may also serve as part of a contingency plan in the event that circumstances surrounding COVID-19 change again. In summary, the COVID-19 pandemic poses an enormous challenge for conducting student research, and we hope this editorial encourages students and faculty to engage in thoughtful discussion, plan ahead, and identify creative solutions for moving student research forward.

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DISCLAIMERS

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DISCLOSURES

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S.J.E. and J.J.D. conceived and designed research; S.J.E. drafted manuscript; S.J.E. and J.J.D. edited and revised manuscript; S.J.E. and J.J.D. approved final version of manuscript.

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