TEACHING INNOVATIONS

Keeping environmental physiology education up and running during the COVID-19 pandemic

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Abstract

The COVID-19 pandemic provoked a need for rapid adaptation of teaching strategies and learning environments. Thus novel approaches, predominantly based on online/virtual platforms are needed to minimize the negative effects of the pandemic on teaching (and learning). Herein we describe our recent web-based symposium series on environmental physiology and ergonomics initiative as an example of such a strategy. We outline the ideas behind this series and its implementation, which could serve as an example of a useful joint interactive virtual educational environment that could be applied to any physiology subspecialty. Based on the feedback received from all stakeholders involved in the process, we strongly believe that such an approach can provide an excellent platform for all educational levels from undergraduate students up to seasoned academics. Importantly, the unrestricted availability (free registration and publication of recordings and student handouts) is an important consideration for the democratization of science and the inclusion of financially less well-supported students and academics.

asynchronous; online seminar series; synchronous

The COVID-19 pandemic forced many lecturers and academics across the world to rapidly and radically adapt their teaching strategies and learning environments to an online/virtual system, and physiology was no exception. This rapid change, coupled with overall challenging living conditions in most countries, had large ramifications for the academic environment. To minimize the negative effects of the pandemic on teaching (and learning) physiology novel approaches are undoubtedly warranted (1), such as the recently provided recommendations and suggestions to facilitate online teaching of physiology by Petzold (2). In addition, the opportunities for research dissemination and networking at scientific conferences were restricted, which could stall scientific and career developments, especially for early career researchers (ECRs) (3).

Harnessing these constraints, we (university-based scientists from three countries) initiated a symposium series on environmental physiology and ergonomics shortly after the initial pandemic lockdowns in spring 2020 to provide students, lecturers, and scientists from around the world with a platform for learning, interaction, and dissemination. This short article aims to outline the ideas behind this series and its implementation, which could serve as an example of a useful joint interactive virtual educational method and could also be applied to other physiology subspecialties.

The series originated on Twitter through one of the authors offering to help instructors with online guest talks. This was followed by the two other authors responding with their willingness to contribute guest talks within their specialties and then rapidly coalesced into a decision to jointly organize a symposium series. Initial idea input was solicited through tweets and Twitter polls. This highlights the emerging and continued utility of social media, and especially Twitter, as a venue for scientific discourse (4).

Some of our major philosophical underpinnings included the following:

1) The talks would be free to attend synchronously and to access afterwards asynchronously. Beyond reduced travel funding from the pandemic, our wish was to democratize knowledge exchange across a wider audience than possible with a one-time talk or a traditional live conference.

2) Sessions should be developed to cover all aspects of environmental physiology from basic physiology to its translation to real-life situations. The sessions would involve strong, current research talks but should also be suitable for undergraduate and graduate teaching. For example, teaching guides would be included in as many sessions as relevant and possible.

3) Diversity would be targeted across topics, gender, and career stage, with particular emphasis on providing an opportunity for doctoral students, postdoctoral researchers, and other ECRs.

As it is long known that long-duration “passive” lectures are not optimal regarding attention and knowledge retention (5), we designed the series such that the talks (usually 2 per
session) are around 20–25 min long with sufficient discussion time after each talk and overall discussion on the topic during the concluding part of the session. This enabled all of the participants to get actively involved to contribute to the topic at hand. Each session was moderated by one of the organizers with participants being able to interact with the panelists and pose questions via the question and answer (Q&A) tool in the Zoom webinar platform. Speakers answered questions both “live” following each talk and also typed online while other talks were proceeding.

Although most sessions were scheduled to accommodate the North American and European time zones of the hosts (1600 GMT), roughly one out of four sessions were scheduled at an alternate timing to accommodate synchronous attendance in Asia and Oceania (usually 0900 GMT). The dominant time zone spanned early morning on the west coast of North America through to early evening in Europe, while the alternate time spanned morning in Europe through to evening in Asia and Oceania. This timing and alternation were popular with attendees and did not impact synchronous attendance.

Importantly, to facilitate active learning/engagement, all of the speakers provided student handouts that were published alongside the lecture recordings and consist of the topic summary along with topical revision questions. This feature benefited both the students as well as the lecturers as it provided an easy-to-use learning and revision tool that can be used in all university settings.

From the start of the pandemic in early March until now (April 2021), we have organized 24 symposia, involving a Mary along with topical revision questions. This feature benefited all of the speakers provided student handouts that were published alongside the lecture recordings and consist of the topic summary along with topical revision questions. This feature benefited both the students as well as the lecturers as it provided an easy-to-use learning and revision tool that can be used in all university settings.

Have our goals been achieved and what were lessons learned?

Aim 1: The talks would be free to attend synchronously and to access afterwards asynchronously:

- Synchronous and asynchronous participation: The sessions had ~2,000 synchronous participants overall. The number of synchronous participants declined over time (see Table 1) despite regular institutional and Twitter-based promotion. Hosting the sessions on YouTube (Environmental Ergonomics channel) has permitted asynchronous viewing, and, to date, the series have gained >11,000 total views on YouTube across all continents, with >1,800 h of total viewing time.

- Free access: Costs associated with the series (Zoom Webinar subscription ~ $1,500/yr for up to 500 attendees per session; website domain and hosting ~ $1,000/yr; YouTube subscription free) were not passed on to the attendees and were covered by a fund originally meant for planning a live conference. Considering the cost for conference organizing and attendance, the much greater reach and comparative cost efficiency of this online series certainly highlights the potential for scientific dissemination via such venues. The low cost of our series could easily fit within institutional or corporate sponsorships.

Aim 2: The sessions would involve strong, current research talks but should also be suitable for undergraduate and graduate teaching. Teaching guides would be included in as many sessions as relevant and possible.

- Session content: The mix of laboratory and applied science has been strong. For example, a cold physiology session featured a talk on cold and muscle metabolism, followed by a scientist/athlete discussing the mix of science and logistics involved in her successful English Channel swim. Another session featured a talk on the science of heat adaptation, followed by a talk by a scientist/athlete and her incorporation of heat adaptation in her preparation for the Marathon des Sable.

- Teaching guides: Instructor guides have been included for nearly all sessions. One author’s undergraduate course used sessions as part of a problem-based case study (e.g., the theory and application of altitude or heat training), with the video being required viewing before synchronous small group work to develop ideas further. The graduate course used the sessions to introduce students to a particular topic (e.g., altitude effects on metabolism), followed by a detailed discussion of specific papers in the area.

Aim 3: Diversity would be targeted across topics, gender, and career stage:

- Topics have been selected to cover most environments within the broad field of environmental physiology, including heat, cold, hydration, altitude, microgravity, apnea diving, chronobiology, and pollution. Further talks have focused on specific methodology (e.g., sweat or skin temperature measurement) and sex differences, along with ones with high topical relevance (e.g., heat

### Table 1. Factors to consider when organizing and running a global webinar-based series in physiology

| Factors                  | Options/Suggestions                                                                 |
|--------------------------|-------------------------------------------------------------------------------------|
| Platform                 | Low cost and easy to access, e.g., Zoom, WebEx, YouTube, Facebook Live             |
| Speakers                 | Diverse and ranging from ECRs to senior leaders in the field                        |
| Topics                   | Basic scientists through to practitioners (coaches, physiotherapists) and end users (e.g., athletes, patients) |
| Specific vs general      | Broad range to promote diversity and collaboration, along with expanding symposium reach Field-specific methodology Hot topics or ones with timely relevance, e.g., Tokyo Olympic Games |
| Timing                   | Flexible to enable synchronous attendance across the globe                           |
| Interactivity            | Q&A, discussion among panelists                                                    |
| Talks availability       | Posting on YouTube or some other venue to ensure asynchronous access               |
| Promotion and “marketing”| Social networks, e-mail lists                                                        |
| Additional features      | Student handouts                                                                    |
| Obtaining feedback and improving content | Polls, personal interactions |

ECRs, early career researchers; Q&A, question and answer.
planning for Tokyo Olympics, impact of protective gear on heat stress in health care workers).

- Gender diversity has been good (35% (18/51) female speakers), and three sessions had an all-female panel. We will strive to match or exceed this percentage in future series.
- Twenty-five percent (13/51) of speakers were ECRs (doctoral or postdoctoral). One ECR speaker used her talk, along with its strong synchronous and asynchronous attendance, as partial evidence of her international expertise and stature in her successful job search and application for a work visa in the United States.

The symposium series has also spun off knowledge mobilization efforts in the field. One symposium focused on science communication led by a sport science journalist and best-selling author. Since February 2021, one of the authors has created weekly short scientific communication videos on different topics within environmental physiology, hosted on the same YouTube channel. The intention is to build a community of scientist and student video creators to enhance knowledge mobilization of environmental physiology. Currently, two graduate students have contributed videos, creating a further avenue for student training and networking. It is hoped that the channel will be a live resource and in future we will encourage complementary contributions, e.g., versions with captions in different languages and complementary resources such as accompanying quizzes (e.g., Kahoot).

Overall, we strongly believe that such an approach can provide an important added value to other educational methods in the current (and future) virtual settings and could, moreover, be employed in all physiological subdisciplines. It seems that the employed system can provide an excellent platform for all educational levels from undergraduate students up to seasoned academics. Importantly, the unrestricted availability (free registration and publication of recordings and student handouts) seems to be an important consideration for the inclusion of financially less well-supported students and academics, especially in these undoubtedly difficult and challenging times. We encourage other physiologists to harness this idea and engage with their respective communities to provide similar platforms.

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**DISCLOSURES**

No conflicts of interest, financial or otherwise, are declared by the authors.

**AUTHOR CONTRIBUTIONS**

C.J.T., T.D., and S.S.C. drafted manuscript; C.J.T., T.D., and S.S.C. edited and revised manuscript; C.J.T., T.D., and S.S.C. approved final version of manuscript.

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