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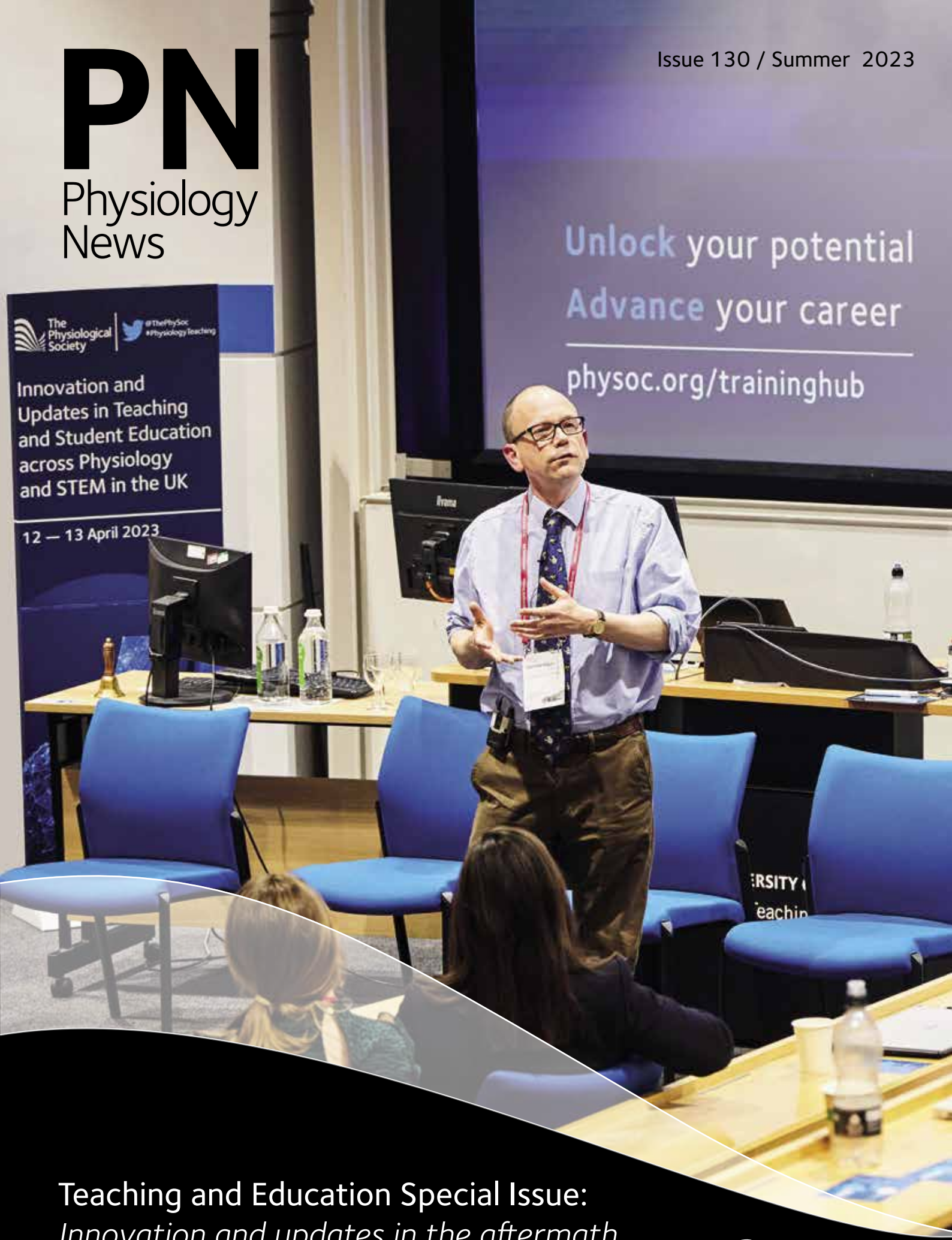
PN Physiology News



Teaching and Education Special Issue:
Innovation and updates in the aftermath of COVID-19

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Welcome to the Summer 2023 edition of *Physiology News*

Introduction

News and Views

Features

Events

Membership

Cover image: Photo of Professor Matthew Mason, University of Cambridge, presenting at the *Innovation and Updates in Teaching and Student Education* meeting

Apply for one of The Physiological Society's grants

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Deadlines: 31 July, 31 October 2023

Professional Development Award

Funding to visit a lab or attend a training course for the development of a specific skill or technique

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The Physiological Society

How is higher education changing in the aftermath of the COVID-19 pandemic?

Dr Charlotte Haigh, Dr Ruth Norman and Dr Chris Randall

University of Leeds, UK

Programme organisers for our meeting *Innovation and Updates in Teaching and Student Education across Physiology and STEM in the UK* that took place at Leeds in April 2023.

The COVID-19 pandemic has heavily influenced higher education, leading to increased opportunities for virtual and remote learning, as well as the traditional face-to-face interactions. Consequently, this has triggered a wave of innovations in student education, such as the use of technology, online resources, and alternative methods of assessment. With these changes, it is imperative that we reflect on our teaching practices, ensuring we meet the learning needs of our diverse student populations, we prepare them to be global citizens, we think carefully about the content in our curriculum design to avoid overload and enable students to gain the most from their assessments by providing valuable and accessible feedback. All of these aspects were discussed at the recent 'Innovations and Updates in Teaching in Physiology and STEM Education' symposium held at the University of Leeds, 12- 13 April.

Nicholas Freestone (Kingston University) opened the symposium with the benefits of the levels of data that his institution collects and uses to inform about awarding gaps down to individual assessment pieces. He discussed a variety of interventions aimed at all students such as summer scholarships, which have been shown to increase engagement and decrease awarding gaps in his student cohorts.

A greater appreciation of different cultures and languages will produce global citizens who help promote a better understanding of diverse populations. Pam Birtill (University of Leeds) provided insights into her work with students and staff in understanding what exactly global citizenship means so that appropriate training and resources can be produced to enable the effective instruction and practice of these skills in a modern curriculum.

Teaching core concepts in each subject area remains critical. Instructors should ensure that students have a solid foundation in each discipline's core concepts, aiding with the advancement of higher learning in that area. Blended learning provides the opportunity for developing courses with core subjects aligned with design-thinking methods. It encourages educators to be innovative in their teaching practices, recognising the importance of encouraging students to think critically. Derek Scott (University of Aberdeen) outlined some key work in this area. Working alongside the American Physiological Society, Derek was pivotal in developing core concepts, but was clear that not all courses need to be able to demonstrate teaching all the core concepts and using a "pick and mix" approach was just as valuable.

The assessment of students remains a critical aspect of all learning, and students require useful feedback that helps them to improve their understanding of studied concepts. Instructors need to provide structured feedback guides that help to evaluate students' performance. Using a variety of approaches, such as discussion forums, written feedback, audio or video recordings, and rubrics, increases the likelihood of engagement with feedback. As a result, students can learn to identify areas of strength and weakness and use feedback as part of their ongoing self-assessment. Damian Parry (Newcastle University) talked through the pedagogy and then some practical interventions with evidence of positive effects of student engagement with feedback in his discipline.

Innovation plays a crucial role in higher education, with educational institutions ensuring they are innovative in their teaching practices. Instructors must be resourceful and creative, exploring new approaches to teaching and how to engage with all learners effectively. Virtual simulation and web-based technologies coupled with augmented reality and AI make the learning experience immersive and engaging. The flash presentations in this symposium really emphasised the innovative nature of physiology educators and their willingness to be brave and try new things, while maintaining a collaborative design approach so we move forward as a community. Educational institutions and the physiology discipline must embrace innovative strategies to meet new challenges.

The COVID-19 pandemic continues to change higher education, leading to a shift in focus from traditional learning methodologies to optimal blended modalities. As educators, it is essential that we strive to be innovative, adopting new strategies in our teaching practices. By recognising the significance of inclusive teaching, promoting global citizenship, utilising core subject concepts to define the curriculum, and engaging in an active feedback process, we can help to produce students who are prepared for life. Therefore, it is essential and we recommend embracing the new ways of thinking that straddle both the remote and physical worlds, creating educational value that is inclusive, responsive, innovative and promoting meaningful social impact.

The COVID-19 pandemic continues to change higher education, leading to a shift in focus from traditional learning methodologies to optimal blended modalities. As educators, it is essential that we strive to be innovative, adopting new strategies in our teaching practices.

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Celebrating our vibrant community

We thank you for your fantastic contributions to The Society

Dariel Burdass

Chief Executive,
The Physiological Society

Volunteering has been very much in my thoughts with the 'Festival of volunteering', which took place on Monday 8 May 2023, highlighting the positive impact volunteering has on communities across the nation, through to Volunteers Week, an annual event, which takes place during the week of 1-7 June every year.

As I reflect on the benefits, in terms of skills, knowledge and experience I have gained from my various volunteer roles across the STEM sector as well as the friendships made, I would like to take this opportunity to recognise the fantastic contribution volunteers make to our Society and say a big thank you.

Our diverse, dedicated, and enthusiastic volunteers are one of our greatest assets. They are a vital part of the work we do, from assisting us in the development and advocacy of our activities and programmes to raising the visibility of physiology, physiologists, and The Society. Our community remains strong and vibrant due to the level of engagement and commitment from our members. If you have not volunteered for The Society before, please don't be shy; there are lots of ways you can get involved even if you only have a small amount of available time.

Have you thought about micro volunteering? Micro volunteering is volunteering for short tasks that may make up a larger project. This type of volunteering offers the opportunity to undertake bite-size activities, many of which can be online. If you have more time to spare there are opportunities to help with a one-off event or provide long-term support to a Society project.

Volunteer opportunities include

Whether it is through our governance roles, engagement or advocacy work, the Society provides many opportunities to enable you to get involved with your community, which is a fantastic way to gain new skills, or use existing ones, and to build your network. Examples include:

- Amplifying our reach through social media advocacy – our current campaign is #physiologychangestheworld
    - Twitter – Follow us, re-tweet us or tell us what you're up to
    - Instagram - Like us and share our posts
    - Facebook – Like us and share our posts
    - LinkedIn – Share our posts and write your own on our group page
- Serving on our committees and working groups that help deliver our activities
- Organising a two-day scientific meeting to bring your community together
- Representing your institution and supporting the membership by becoming a Society Representative
- Reviewing our grant applications
- Contributing evidence and insights to support the development of our policy work in key areas that are important to members and to physiology as a discipline.
- Sharing your research through our various communication channels including *Physiology News, Let's Get Physiological* podcast, and the blog
- Becoming a peer reviewer for the Society's journals. Join a dedicated team that is assessing the validity, quality and often the originality of articles for publication to maintain the integrity of science in the journal by filtering out invalid or poor-quality articles.

Benefits of volunteering

Research has demonstrated that volunteerism and community involvement offer benefits both to communities and to volunteers themselves.[1] When you are giving up your time, skills, and services to help both The Society and our community then it is important that you get something back both personally and professionally. Every volunteer gets something different from their volunteering experience, including the opportunity to:

- develop new skills in new areas
- improve mental and physical health and wellbeing
- work on projects you ordinarily wouldn't have the chance to
- build new connections and networks
- increase your employability
- support career progression
- give back to your community
- have fun

What our volunteers say

Most of our volunteers have specific reasons for what they do. We share a few below:

Professor Áine Kelly, Trinity College Dublin
"Being a Society Trustee is one of the most meaningful activities I engage in as a physiologist. In particular, working with colleagues on the policy group has emphasised to me the importance of directly engaging with the policymakers whose decisions shape all our lives. Through The Society's work, I've had the opportunity to participate in activities in both the UK and Irish parliaments where we highlight the importance of physiology as a discovery science and how physiology knowledge is fundamental to preserving and improving the health of the human population and the planet as a whole, now and in the future."

Dr Richard Siow, King's College London
"During my time as a member of The Physiological Society I have co-chaired a project looking at quantifying the value of knowledge exchange associated with

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physiological research in the UK, a further project looking at the value of physiological guardrails for the introduction of AI into healthcare settings, as well as provided numerous case studies supporting The Society's policy work promoting healthy ageing.

As important as this impact is, the value of these reports goes beyond meeting with and informing policymakers about the contribution of UK science. They have also helped me to build and establish new links with academic colleagues, funders, industry and civil servants to broaden the impact of my research.

Policy work has also given me the opportunity to share my experience and advice with early career researchers and stress the value of research impact beyond the traditional publishing model.'

Dr Catherine Kirby, University of Huddersfield

"I promote the undergraduate Physiological Society membership to students in Biological Sciences at the University of Huddersfield. We do not have a named physiology degree course, but it is a subject that is central to all the students in years 1 and 2. Some students really enjoy the challenge of physiology and wish to continue to study physiology at the post-graduate level, so membership of the society provides them with the opportunity to explore careers in physiology.

The Society has been very generous in funding outreach activities with local high schools. We have invited GCSE pupils to carry out physiology investigations that support the Biology GCSE syllabus but cannot run at school, e.g. cardiac physiology. We have also run outreach activities that look beyond the GCSE syllabus to encourage them to be inspired by physiology. We run fun and engaging activities in the local primary school to promote 'Physiology Friday'.

I value the support of the Physiological Society as I feel it makes my interests more substantial when the students can see that there is a wider community outside their chosen university degree course that has an interest in physiology."

If you would like to find out about the current opportunities and how to become a more active member, please get in touch with our Membership Engagement Manager Jen Happe jhappe@physoc.org

The Society is a membership organisation. As always, please call me, email me, invite me to come to your lab, and let me know what we do well, where we could do better, what we might stop doing and what we could do more of.

See you at Harrogate for *Physiology 2023*!

Footnotes

1. https://www.researchgate.net/publication/301217915_Understanding_and_encouraging_volunteerism_and_community_involvement.

Policy Committee meeting report

The Policy Committee met virtually in March 2023 to discuss The Society's policy aims for 2023. Professor Mike Tipton (University of Portsmouth, UK), as Chair, welcomed members of the Committee.

The main agenda item was the policy work plan for 2023, in line with The Society's new strategic priority to "play an influential role in shaping funding and public policy". The Committee agreed that future policy projects must directly reflect the five objectives of The Society.

The Committee received a paper on work of The Society's *in vivo* taskforce. The role of the taskforce is to discuss the key issues facing members performing research involving animals. In a separate meeting, chaired by Professor Lucy Donaldson (University of Nottingham), the taskforce met to discuss issues facing the *in vivo* community including the MRC's new policy requiring experimental designs and analysis to include both sexes.

The Committee discussed three areas of policy: a policy project focusing on increasing The Society's engagement with members in the Republic of Ireland, a project looking at the role of future technologies identified by the UK Government and how physiological research can support them, and a third project sitting at the interface between physiology and extreme environments within the context of the climate emergency.

The Committee also received reports on The Society's other successful policy projects for 2023, including the roundtable on 'economic inactivity, health and older workers' and the event in Scotland highlighting the role of Scottish research in meeting the UN's Sustainable Development Goals (SDGs).

https://doi.org/10.36866/pn.130.7

The future funding for basic research in Ireland

Shania Pande

Policy Officer,
The Physiological Society

Ireland is world leading in science, research and development, including the physiological sciences. Physiology expertise in Ireland ranges from respiratory physiology, oncology and neuroscience, to sport and exercise science.

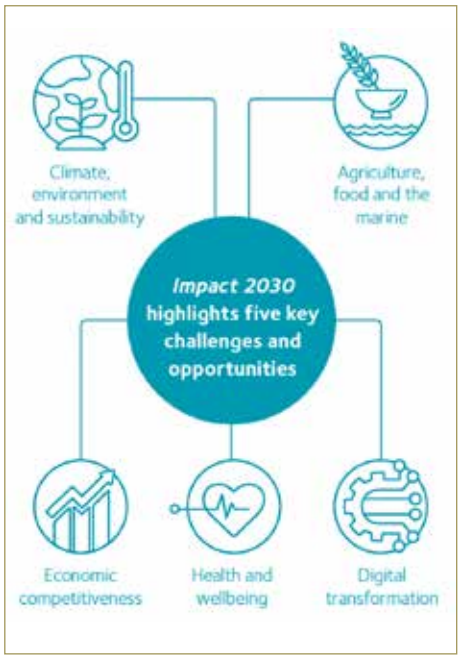
Members of The Physiological Society carrying out physiology research and teaching in Ireland have been at our core since our foundation in 1876. Gerald Francis Yeo from Trinity College Dublin was one of 19 physiologists who first gathered to form The Society. He also served as the Secretary of The Society until 1889 and campaigned for the value of *in vivo* research in response to Victorian anti-vivisection campaigns.

Despite the tremendous growth of the Irish economy over the past few years, the Government's overall investment in R&D has not been made at the same rate. Ireland has achieved limited progress towards the *Innovation 2020* report's research intensity rate target of 2.5% of GNP, which rose from 1.55% in 2015 to an estimated 1.63% in 2020.

Comparative analysis between Irish investment in R&D and that of other similar countries is further complicated by the Irish Government's use of an economic metric other than GDP called 'modified Gross National Income' (GNI). This was developed in the aftermath of the financial crisis in 2008 to take into consideration the disproportionate impact of multinational corporations based in Ireland on Irish macroeconomic data.

In 2022, the Irish government announced *Impact 2030: Ireland's Research and Innovation Strategy*, an R&D innovation strategy designed to maximise the impact of research and innovation on many national priorities. It will progress objectives shared across the Irish research and innovation system, such as maximising its impact on public policymaking and implementation, and nurturing and attracting talent.

As a part of this *Strategy*, the government has proposed the merger of Science Foundation Ireland and the Irish Research Council through a Research Bill designed to improve and enhance interdisciplinary research in key challenge areas such as health and wellbeing, climate change and sustainability.



This merger has raised concerns about the future funding of basic research in Ireland. Physiology is an interdisciplinary science but also one that has suffered from the lack of prioritisation for basic research in Ireland. To this end, The Society held an event in the Houses of the Oireachtas, to discuss how the prioritisation of basic research can help to meet the key challenges presented in *Impact 2030*.

The event, kindly hosted by Senator Tom Clonan, brought together Irish researchers, physiologists, and members of both the Dáil and Seanad to discuss the value and contribution of basic research to R&D in Ireland following the publication of the Heads of Bill for the upcoming Research Bill and the *Impact 2030* framework.

We heard speeches from Senator Clonan, Dr Olga Piskareva from the Royal Irish Academy, Dr Ruth Freeman from Science Foundation Ireland and Professor Áine Kelly from Trinity College Dublin representing The Society. In combination, their speeches demonstrate the key role science has to play in responding to the major societal challenges of our time and the importance of basic, curiosity-driven research in driving translational research.

The Society produced a short report ***Physiology and Basic Research in Ireland*** for this event, highlighting physiological expertise in Ireland and its role in supporting the Irish R&D and innovation ecosystem with some examples from higher education institutions across the country. One such example was from the Dundalk Institute of Technology wherein researchers are identifying novel therapeutic targets for the treatment of chronic obstructive pulmonary disease (COPD).

In the coming months, The Society will be working closely with Irish members and other learned societies to take forward the recommendations from the meeting and ensure that future funding schemes represent the interest of physiologists and researchers within Ireland to put physiology at the heart of *Impact 2030* and the *National Grand Challenges Programme* in Ireland.

The Physiological Society and its members continue to demonstrate through reports such as *From 'Black Box' to Trusted Healthcare Tools* that physiological research is key to creating a healthier, more sustainable, equitable and economically prosperous society. Our report *Physiology and Basic Research in Ireland* and further information about our policy work can be found at: **physoc.org/policy**

Left to right: Professor Áine Kelly (Trinity College Dublin), Senator Tom Clonan and Dr Ruth Freeman (Science Foundation Ireland).

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STEM for Britain 2023: Hijacking cancer gene regulation

Isabel Esain

University of Cambridge, UK
The Physiological Society Prize Winner 2023

My name is Isabel Esain and I'm a 25-year-old scientist from Spain. I studied my undergraduate degree in Biochemistry at Imperial College London while jointly pursuing music studies at the Royal College of Music, after being awarded the prestigious Music Scholarship from Imperial College. My scientific interest for biophysics and genome editing led me to carry out research at Harvard University (US) and the University of Cambridge (UK), where I worked on developing new technologies for precision genome engineering. I then pursued my PhD at the University of Cambridge to feed my curiosity and fascination for how the human genome is read and interpreted. Here I have been working on how genetic information is encoded in the topological structure of DNA under the supervision of Professor Sir Shankar Balasubramanian.

Discovering molecular master keys in the human genome

The genome is regulated through chemical modifications which decorate the DNA, known as the epigenome. In cancer, abnormal epigenetic patterns lead to changes in the 3D shape of DNA which allows it to be recognised differently by the cellular machinery. My PhD project is based on the novel idea that alternative DNA structures, called G-quadruplexes, are epigenetic features of the genome that play critical roles in gene expression, particularly for cancer-related genes.

The key experimental goal was to dissociate the effect of DNA structure from that of the genetic code primary sequence. To address this question, I pioneered a new genome and epigenome editing approach to modulate G-quadruplex formation in cancer cells. My findings reveal that DNA G-quadruplexes are acting like molecular master keys to control crucial molecular processes that regulate gene expression in cancer genes. This discovery overturns standard dogma and expands our understanding of how genetic information is encoded in the genome.

Left to right: Stephen Metcalfe, Professor Mike Tipton, Isabel Esain and Stephen Benn, 3rd Viscount Stansgate

The most exciting part of my research is working on a novel concept with the potential to have a positive impact in the world, in a highly collaborative and multidisciplinary group. Generating ideas and applying them to develop something new can be a challenging process, it requires a lot of scientific decision making, working under pressure and learning to deal with failure and success. It is very important not only to be an independent and open-minded researcher but also to work effectively in a team. Working with others to find creative solutions to problems and having everyone's perspectives to benefit the team is key for success in science, and this is something I experienced first hand.

Transitioning from research discoveries to therapies and health policies

I entered STEM for Britain because I think one of the most beautiful things about science is having the opportunity to share your discoveries and motivation with the wider community. The fundamental science that we do is so vital to society, medicine and industry. I believe that the future of medicine will rely on genetic methods for personalised treatments and precision therapies. Hence, translating the progress from a laboratory bench to influencing policymaking is crucial for a coordinated effort between scientists, policymakers and health regulators.

Being selected as one of the finalists and having the chance to present my discoveries in front of MPs and members of the parliamentary scientific committee was an

Left to right: Professor Constantinos Soutis, University of Manchester, UK and Isabel Esain

incredibly inspiring experience. It definitely made me think about how the work I do fits into today's society. All the research in the room was groundbreaking; that's why I could not believe it when I was awarded the Physiological Society Award 2023 this year. Receiving such a prestigious award and seeing interest from everyone in the work I do every day drives me to continue working hard. I am striving to take us closer to a future of precision medicine tools.

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See you!

Dr Peter Kohl

Editor-in-Chief,
The Journal of Physiology

One of my neighbours is an accountant. A chief accountant, no less. We recently talked about work-related travel, as I shared my excitement about being able to interact with colleagues elsewhere in person again (I had just returned from one of the Gordon Research Conferences and was full of 'buzz' and, I felt, exciting ideas).

He was not impressed.

In his corporate world, the corona-driven move towards virtual interactions was a blessing, as far as he was concerned: one can see anyone, regardless of where they are in the world, without even having to set foot out of the door. No travel costs, no delays and missed connections, no jet lag, no time away from loved ones. In short – no need to meet (in person)! Following on from this thought and being in control of finance at a medium-sized international enterprise, he had successfully prevented the return of in-person meetings by setting travel reimbursement caps to levels below actual cost. A neat saving.

Why didn't we have the aforementioned conference as an online event, he wondered, adding that we ought to be aware of the importance of reducing our CO_2 footprint, too.

No arguing with that! So, why didn't we have a virtual conference? After all, there are indeed very strong arguments for reducing travel and for using virtual interactions wherever plausible. But – how does one define what is plausible?

Science is a creative process that thrives on and advances by discourse. It draws inspiration from interpersonal exchange. Now – try to read a room while looking at stamp-sized portraits, assuming all participants leave their cameras on. Try to have a lively discussion among multiple individuals via audio channels that have a lag time. Try to focus on your screen, occasionally checking your own image (while hoping to not become too self-conscious), for extended periods of time. In fact, one of the (surprisingly few!) experimental studies into the effects of virtual formats on meeting outcomes concludes: *"videoconferencing hampers idea generation because it focuses communicators on a screen, which prompts a narrower cognitive focus."* [1]

For international meetings, there is the additional challenge of joining up people based in different time zones. One can always aim to assign the night hours to the 'biggest gap' in terms of global distribution of participants, but if your meeting involves people from 16 or more time zones – it leaves a 'night gap' of eight hours or less. This means that some participants (usually those who are based outside Europe and the Americas) will run out of sociable hours very swiftly indeed!

It seems to me that virtual formats are great for 'broadcasting' (say, a one-hour lecture) or 'receiving' (e.g. listening to that lecture – if recorded, even in your own time or at your own pace). But, online meetings are limited in terms of size (up to a dozen people?) and duration (up to three hours?) when you need to both 'broadcast *and* receive'. Yet, that is the very essence of scientific discourse.

All this is even before one considers the considerable value of informal learning from and about other teams, of peer exchange that may inform future professional decisions, and of social interactions that, among others, help to shape the scientific culture in a subject and aid the inclusion of new generations of researchers into our communities.[2] Unsurprisingly, the lack of networking opportunities has been highlighted as the main drawback of virtual meetings by 69% of participants in a recent *Nature* poll on the topic.[3]

Thus, virtual formats are amazingly well-suited for lectures, 1:1 discussions, or small-group meetings (from a lab seminar or a project viva to those admin sessions of my neighbour). They are here to stay as one of the unquestionably positive lessons learned during the COVID-19 pandemic! But virtual formats are less than ideal for creative processes, and they don't work well for international and/or multi-day meetings – regardless of whether these are small and focused, such as a Gordon Research Conference, or larger community conventions, such as Physiology 2023, when an all-hands-on-deck approach is required.[i]

With the latter in mind, I hope to see you at Physiology 2023 in Harrogate, where *The Journal of Physiology* will host a symposium on "Pacemaking in Multi-Cellular Organ Systems". I trust this symposium may start a tradition whereby *The Journal* has a tangible presence in terms of the scientific programme at the main annual event of The Physiological Society. Anything that strengthens the links between *The Journal* and The Society's membership is a good thing – of that, I am convinced.

The "pacemaking symposium" topic will subsequently feature as one item on an extensive list of Special Issues, which we are currently preparing. Special Issues are an exciting means of adding focus to the exemplary breadth of *The Journal*, and – with some 20 topics in the pipeline – they will hopefully offer a home for your most exciting research in the very near future, too! As a welcome additional benefit, we expect that this initiative will, for the first time in years, raise the annual number of manuscripts submitted to *The Journal*. This is important capital in our bid to manifest and consolidate a position of strength for The Society's international flagship and main income generator.

I should like to conclude by noting that this will be my last *PN* column as Editor-in-Chief: I shall be stepping down from this highly esteemed position, which I feel fortunate to have been allowed to fill for a time. I would like to thank the Editorial Board of *The Journal* for the wonderfully creative, highly constructive, and impeccably respectful interactions, The Society's Publications' Team (past and present) for their professionalism, commitment, patience and support for my strategic vision of 'procuring more and publishing better papers', and The Society for the opportunity to serve.

As a journal, we are on the right track, I think. Let's see.[ii]

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1. https://www.nature.com/articles/s41586-022-04643-y
2. https://blogs.lse.ac.uk/impactofsocialsciences/2023/03/13/scientific-conferences-why-meeting-face-to-face-still-matters/
3. https://www.nature.com/articles/d41586-021-00513-1

Footnotes

i. Whether there is a place for large face-to-face 'PR events' of institutions and societies is, perhaps, questionable.

ii. In keeping with the custom of my previous columns, let me add that, while "you can't say we're satisfied – you can't say we never tried" (Richards / Jagger, Goats Head Soup, 1973).

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From pitfalls and pressures to culturing curiosity and creativity in early career physiologists

Professor Damian M. Bailey
Editor-in-Chief, *Experimental Physiology*

Mads Fischer
University of Copenhagen

Professor Christian Aalkjær
Aarhus University

Professor Niels H. Secher
University of Copenhagen

Life as an early career researcher (ECR) isn't easy: from doctoral candidates and postdoctoral fellows to recently appointed independent investigators, they represent the largest and most diverse cohort of scientists (Heggeness *et al.*, 2017), yet face unprecedented challenges that make them professionally more vulnerable in this post-pandemic era (Nature, 2020). That over half of 7,600 postdoctoral fellows from more than 93 countries surveyed by *Nature* considered leaving active research because of work-related mental-health concerns and fewer than half would recommend a scientific career to their younger self (Woolston, 2020), stands a clear testament to the pressures they have to endure in an ever competitive, publish or perish world. ECRs spend much of their professional careers "in limbo", lingering in a succession of short-term contracts, battling high workloads and expectations that can derail a healthy work-life balance. The statistics are indeed sobering, with departments now struggling to recruit postdoctoral fellows (Langin, 2022) and with less than 4% of all PhD researchers going on to a permanent position at a university here in the UK (Taylor, 2010), there are calls for systemic change that will require fundamental shifts in policies, processes, power structures, norms and values. While the format of the next UK Research Excellence Framework is currently under review, it is essential that the diversity of career pathways and importance of providing adequate support to ECRs, notwithstanding the lasting impact of COVID-19, are taken into account. So spare a thought for ECRs: they are (y)our most precious commodity, the workforce of the future that we need to protect, support, and inspire, or else they will sink before they swim, perish before they publish.

It is encouraging to see just how committed The Physiological Society is to supporting ECRs with numerous initiatives that can help guide them onto that first slippery rung of a very precarious ladder towards academic progression. The Society has recently launched a new Training Hub, which provides its members with access to resources and workshops to support their career development. This includes guidance on areas ECRs have themselves identified as important, such as applying for grants, networking, publishing and presenting at conferences. The Society's podcast also highlights some broader challenges faced by physiologists in their career, such as dealing with disappointment or juggling parenthood, with advice from experts on how to approach them. Recent addition of the Unlocking Futures Fund also provides financial support to ECR members who face a specific challenge to advancing in their career.

As part of this, *Experimental Physiology* is equally keen to do more for our ECRs, and I felt especially inspired having just returned from a week in Copenhagen having contributed to an annual PhD course under the auspices of the Danish Cardiovascular Academy. This course is quite unique (see below), the brainchild of the late Professor Bengt Saltin (1935-2014) whose classic "Dallas Bed Rest and Training Study" performed at The University of Texas Southwestern Medical Center in 1966 together with his good friend Jere H. Mitchell (1928-2021), culminated in the publication of that unforgettable monograph in Circulation (Saltin *et al.*, 1968) that I encourage all ECRs to marvel and delight at!

Having coined (rather, proven!) that, "humans were meant to move", Professor Saltin was quick to reach out to Professor Mikael Sander and Professor Niels H. Secher (both based at the University of Copenhagen), to establish a PhD course that later became known as 'Integrative Human Cardiovascular Control', to address the mechanistic bases of human cardiovascular physiology with a keen focus on the clinical translational benefits of exercise. The course was quickly established and has since gone from strength to strength, attracting students from every corner of the globe with faculty from 25 countries who represent 'experts' in their respective fields. Its informal and relaxed nature that sees ECRs openly engaging with Faculty Professors in a stimulating and constructive manner was an "instant hit", providing the ideal environment to exercise their creative curiosities as they grappled with some of the more challenging, if not indeed controversial, integrated topics in physiology.

This year's course (22 - 26 May) was special, marking its 20th anniversary, and attracted ECRs from Norway, Iceland, Switzerland, England, Wales, the Netherlands, Germany, USA, Canada, New Zealand, and the host nation, Denmark. It was organised by Mads Fischer, a PhD student at The Department of Nutrition, Exercise and Sport, University of Copenhagen under the expert tutelage of Niels Secher, Professor Emeritus, both from the University of Copenhagen and both talented oarsmen, one current, one past! Fittingly (practising what they preach), the Danish Students' Rowing Club (DSR) at Strandvænget in Copenhagen served as the venue: the view was magical, tempting some of the ECRs to take a swim.

But it wasn't only the view that was inspiring. With presentations as diverse as understanding how the cardiovascular system of the 'drinking giraffe' copes with the orthostatic challenges of gravity, physiological significance of Purkinje cell distribution within the ventricular walls of lions, rhinos, elephants and whales, to staying fit and healthy in space, we were "all" captivated! And a physiology course isn't complete without a practical element, with two mornings dedicated to demonstrations from specialists in the field focused on cardiovascular regulation in the anaesthetised pig and echocardiography/measurement of peripheral flow in humans using ultrasound.

But perhaps the biggest highlight of all was *Experimental Physiology*'s inauguration of the ECR Bengt Saltin Prize. Each ECR was given three minutes and three PowerPoint slides to present their research, with two minutes for questions. The pressure to win was tangible but always constructive and congenial, at what for many, was their very first presentation on an international stage. The prize was awarded to Michael Plunkett from New Zealand, with Anantha Narayanan (also from New Zealand), and Fredrik Hoff Nordum (Norway) as runners-up, nipping closely at his heels.

The whole experience was truly inspiring and quite the breath of fresh air to watch the ECRs enjoy, engage, decompress and re-energise. I couldn't help but think this is precisely the creative antidote to all the pressures and pitfalls that our ECRs currently face!

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Ben, how is it that you manage to make learning respiratory physiology fun?

My reflections on using H5P for developing an interactive workshop for respiratory physiology

Dr Ben Chant

Lecturer in Physiology, The School of Physiology, Pharmacology, and Neuroscience, University of Bristol, UK

Background and development

Student-centred, active learning is one of the cornerstones of engaging students. Increasing student numbers and limited space in lecture theatres has increased the need for low-cost methods for accommodating large numbers of students. To meet these needs I used H5P, a free, mobile-friendly, open-source HTML interface that does not require technical expertise. H5P can be designed from within Blackboard (our online learning environment) so content can be directly embedded and integrated into other teaching material (see Fig.1). One of the benefits of using the course presentation feature in H5P is that it is easy to integrate several tasks into one interactive workshop; for example, fill in the missing words, calculations, drag & drop, multiple choice questions (MCQs), and true or false questions. Previous research has shown that interactive content developed by H5P is effective for *self-paced* and *self-directed* asynchronous learning in physiology (Sinnayah *et al.,* 2021), but with increasing demand for more in-person teaching, my aim was to develop an integrative respiratory physiology workshop using H5P for use in an in-person workshop.

For some context, this workshop was designed for our physiology, pharmacology, and neuroscience first-year students who all take a common physiology unit. This is taken by around 220 students who typically find the core concepts of respiratory physiology challenging. The students had one face-to-face lecture to introduce core concepts, followed by six asynchronous lectures and two practical classes (static and dynamic lung volumes). My initial aim was to find a way of integrating this material, while anchoring it to something that students can relate to daily living. I was listening to Dr Jack Feldmen talk about his career in respiratory physiology on a podcast and they were discussing the integrative aspects of the physiological sigh. Physiological sighs are those spontaneous deeper breaths most humans take roughly once every five minutes. Try focusing on your breath for 10 minutes and count how many spontaneous deeper breaths you take, and you'll see what I mean. After trying this myself, it inspired me to design a problem-based learning session, using H5P, where students integrate the material across the lectures to consider the problem: what are the functions of the physiological sigh.

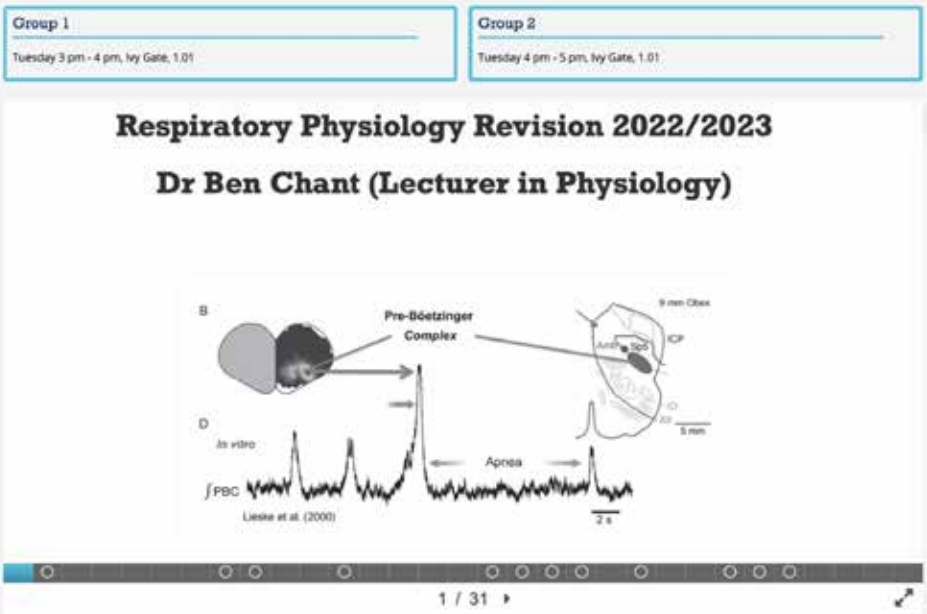

Figure 1. H5P material can be designed in Blackboard before being embedded with teaching material – making it easy for students to access and come back to for revision.

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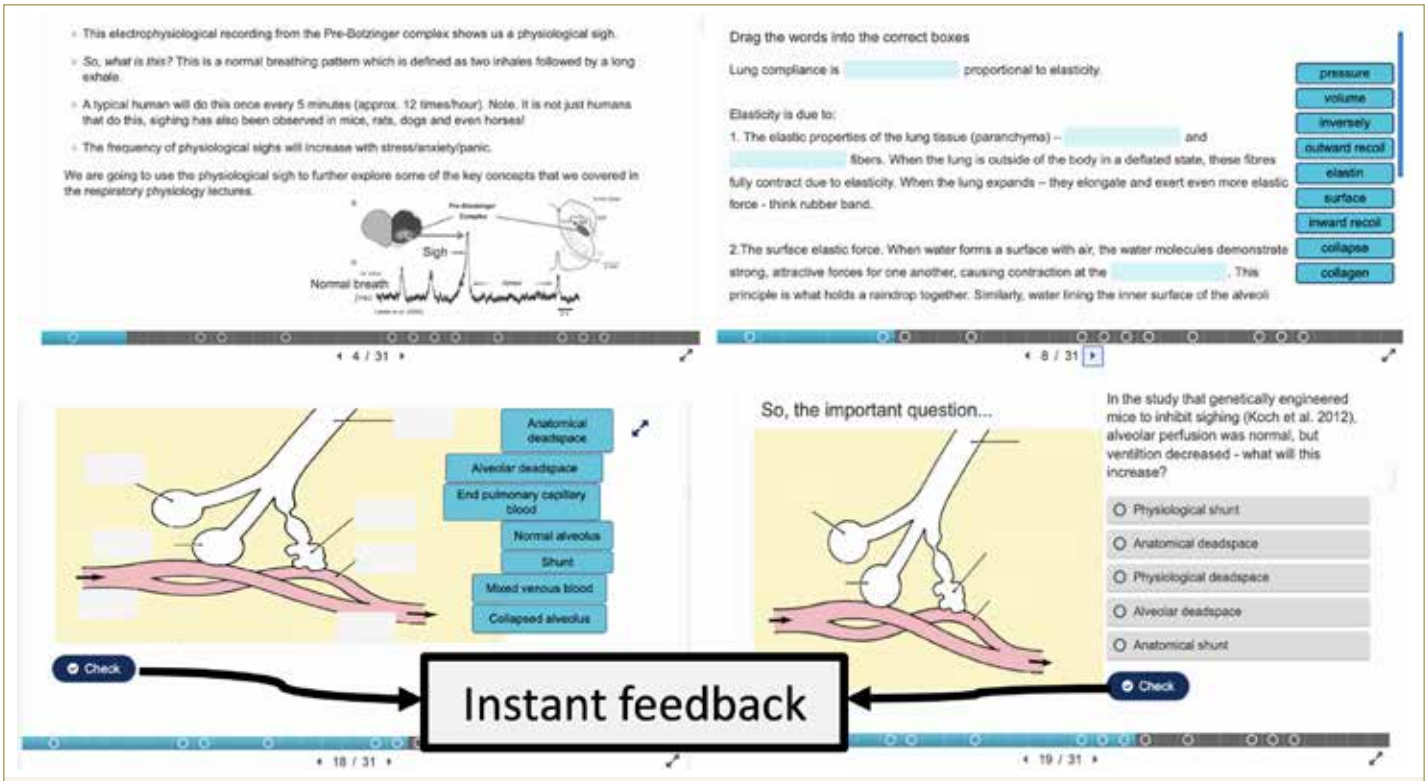

Figure 2. Example tasks from the H5P problem-based integrative workshop on respiratory physiology. Several different tasks can be included in H5P course presentation; shown here are A) short reading tasks, B) drag and drop words into the correct box C) drag and drop with images and D) multiple choice questions. As shown in C) and D), immediate feedback is embedded into tasks to facilitate student reflection on progress with learning.

Reflections and recommendations

I took full advantage of the capabilities of H5P for this session, and integrated various tasks for students to complete, including interpretation of data, fill in the missing words, calculations, Padlets for discussion, drag & drop tasks, MCQs, short clips of YouTube videos and short reading tasks (see Fig.2 for examples). Students were encouraged to work in small teams to complete tasks. H5P offers immediate feedback for each task, and this encouraged self-reflection from the students and helped facilitate conversation about gaps in knowledge and further revision.

Instant feedback

As this was the first year that we used H5P in this format, we did not collect specific feedback from students about the session. However, in their unit feedback one student commented, 'Ben delivered his content very well and the workshop really helped my understanding of each topic.' It's also worth noting that in the workshop, students stated to staff that the session helped them identify gaps in knowledge, integrate material, and to see how the material taught in lectures applies to daily life. Going forward, I will definitely be integrating more H5P course presentations into my teaching, and I plan to think about how this could be used to integrate across topics in physiology (e.g. cardiorespiratory physiology). I plan to collect more feedback from students and assess how this style of teaching impacts their learning. Watch this space...

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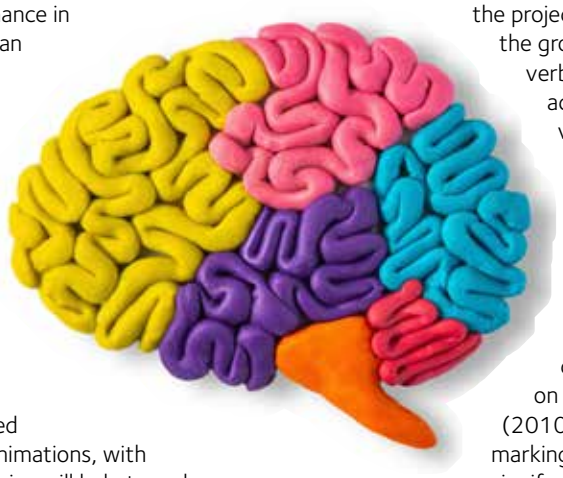
Outreach video assessment for neuroanatomy students

Dr Marta Wołoszynowska-Fraser

Keele University, UK

Neuroanatomy for some can be a complex subject that requires a deep understanding of the human brain and its functions. One way to help students grasp this material is using a variety of resources, such as videos and group activities, to demonstrate key concepts in an engaging and accessible manner (Vujovic, 2016). Videos and animations can help students to better understand complex processes, and breaking down complex concepts into smaller, more manageable parts can provide a visual representation of these processes.

Group work can promote engagement and understanding in students, leading to improved performance in various fields (Freeman *et al.*, 2014). It can also provide opportunities for students to engage in meaningful discussions and deliberations. That is why students have been tasked to work in groups to produce neuroanatomy-related outreach videos or animations, with a hope that this exercise will help to make neuroanatomy more accessible to them.



Second-year neuroscience students were randomly allocated into groups of 6-10 people. They were tasked with creating an outreach video or animation that was aimed at patients and carers. Students had some freedom in choosing a topic, but they were told that it needs to be about pathology linked with neuroanatomy. Groups were advised they can use any form of video/animation; however, a narrated PowerPoint was not accepted. Since creativity has been found to promote problem solving, increase self-expression and versatility (Runco, 2004), students were encouraged to think outside of the box, be creative, and bold.

This assessment was worth 30% of the module grade and was marked based on student engagement with the project as well as the group (25%), verbal skills and accessibility of video/animation (10%), visual aids (10%) and content (55%). A comprehensive marking rubric was created based on Peeters *et al.* (2010). This allowed marking time to be significantly decreased and provided broad and extensive feedback to students. As this was the first group project that these students undertook while at the university, they had an opportunity to get to know each other as well. In the feedback form students have mentioned that they found this assessment stimulating and that it helped them to develop an ability to work as a team member. Students have shown not only a depth of knowledge but also were able to present it in a digestible and creative way.

In conclusion, the use of outreach videos and/or animations for an assessment can be an effective way to help neuroanatomy students to better understand complex concepts and engage with the subject matter. By using high-quality resources and incorporating these tools into teaching and learning, we as educators can improve learning outcomes and help students to achieve their full potential.

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Problem-based learning for authentic assessment in a large class setting

Dr Clare Tweedy

School of Biomedical Sciences,
Faculty of Biological Sciences,
University of Leeds, UK

The core physiological concept of "structure and function" is an important but challenging concept for students to grasp. This is in part due to the overwhelming quantity of anatomical and physiological information, as well as the challenge of understanding how structure and function relate to one another. The use of problem-based learning (PBL) to drive the learning process is one way to address such issues. In PBL, students are asked to search through a large quantity of information and make decisions about what is relevant to learn in a way that is more authentic to how we seek and sort information in a real-world setting. Not only do students consider PBL to be effective and more engaging than traditional lectures (Antepohl and Herzig, 1999), there is evidence that PBL can have positive effects on knowledge retention (McParland *et al.*, 2004) and communication skills (Koh *et al.*, 2008).

While PBL has been widely used in medical schools, implementation in physiology curricula has been hindered in many cases by the lack of staff training in PBL instruction and the time-intensive process of facilitating small groups of students. I therefore wondered if it was feasible to carry out PBL in a large class setting. My aim was to integrate PBL into a 220-student level two module in the School of Biomedical Sciences at the University of Leeds. The first four weeks of the module are centred around neuroanatomy, which means there is a large amount of available information for students to sort through and learn. Not only do students struggle with the seemingly endless nature of anatomical knowledge, they also struggle to integrate their understanding of anatomy with their understanding of physiology and function.

Use of PBL as authentic assessment

An appropriate way to frame a relevant and engaging problem related to anatomy and physiology is through a patient case study. The problem that students are assigned, however, must be sufficiently challenging. Giving the patient ambiguous symptoms, as well as a complicated history, gave students a lot of information to sort through and a clear need to work with each other. Alongside the case study, groups were given a workbook that contained weekly tasks comprised of short-answer questions. The first week centred on the diagnosis of the patient, integrating evidence from the case study with the literature. Students were not marked on whether their diagnosis was *correct*, but rather on whether they could justify a diagnosis using evidence. They were also tasked with creating a figure to illustrate their decision-making process, for example mind maps or flow charts.

Diagnosing the patient was just the first step. In subsequent weeks, students explained the mechanisms underpinning their diagnosed condition then selected a brain structure associated with the case study. They were then tasked with explaining their chosen structure's anatomy and function, before integrating the two together to explain what might have gone wrong in their diagnosed condition. For example, what effect might hippocampal atrophy have on hippocampal function and *how*? This element of choice was well received by students, and from a staff perspective made it more engaging to mark the submissions.

Facilitating large-group PBL with minimal instructors

Had I carried out traditional PBL with this group, I would have been tasked with finding facilitators for 47 student groups. What I instead achieved was large-group PBL with only myself as a facilitator. The workbook replaced the need for heavy staff involvement by structuring and facilitating each week's activities. As well as the questions they were tasked with producing answers to, I also included prompts for them to discuss as a group, and a reminder of what they should have achieved by the end of each week.

Some facilitation for this process was necessary. Weekly workshops were timetabled in a lecture theatre to introduce that week's activities. After that, students could remain working in the lecture theatre or move elsewhere with their group. The process was also facilitated through pre-recorded learning material on neuroanatomy and a lab practical, to help students become more comfortable using anatomical terminology in their short-answer responses.

Ultimately, large-group PBL can be successful with minimal facilitation so long as the facilitation is achieved in other ways. Student feedback was extremely positive and for those students interested in careers in healthcare after their physiology-related degrees, the experience of a clinical case study was invaluable.

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Is simulation the ultimate integrated physiological experience?

Professor Rachel Ashworth & Dr Lauren White

Clinical Skills and Simulation Centre, University of Worcester, UK

An understanding of physiology is a core part of any medical training and key for the development of critical thinking and clinical reasoning skills. Research has shown that the construction and application of physiological knowledge by medical students changes as their expertise increases, so learning activities within curricula should be designed to reflect this (Bandiera *et al.*, 2018).

Supporting student learning

Learning is achieved in a variety of settings using different teaching approaches adapted to suit the needs of students at the appropriate level of their educational journey. For example, undergraduate students that have arrived straight from school may need support to understand core physiological concepts while postgraduate students may well have learned physiology at degree level but are now applying knowledge in different contexts. Constructing effective learning environments to support student learning can be challenging and thus guidance from pedagogical research to assess educational activities, in the context of medical education, is often beneficial.

The General Medical Council (GMC) sets out the requirements for learning that newly qualified medical graduates must demonstrate (Outcomes for graduates, 2018). Within this framework, driven partly by a concern that opportunities for physiology teaching in medical courses are becoming increasingly limited, there is also a physiology curriculum to support those responsible for teaching medical students (The Physiological Society, 2020). Taken together these documents provide a comprehensive outline of the types of physiological knowledge and skills that medical students must acquire during their degree.

One example, taken from cardiovascular medicine, is that newly qualified doctors must have a knowledge and understanding of the electrocardiogram (ECG) and be safe to practise under indirect supervision. Interpreted another way, this can be explained as knowing how to do the skill (i.e., the practical skill of conducting an ECG), what that skill represents (i.e., how the trace relates to cardiac function) and why it is used, integrating the skill into clinical practice (i.e., when is it appropriate to conduct an ECG in practice).

Simulation vs traditional clinical teaching

The Three Counties Medical School, University of Worcester, is embedding simulation into the early years teaching on its four-year graduate MBChB programme. Immersive simulation (SIM-based education, SBE) is already used widely in healthcare training, and there is evidence that it is superior to traditional clinical teaching, in that it improves teamworking and interprofessional collaboration and reduces patient harm.

SBE has been shown to be effective in training undergraduates, postgraduates and faculty and is well liked by educators and learners (McGaghie WC *et al.*, 2010). However, SBE is sometimes seen as expensive and resource heavy, and it is argued that traditional clinical skills, namely the separation of practical skills from integration of knowledge, can be just as effective in delivering the same educational outcomes, especially in the early years and on undergraduate courses. Our MBChB course provides the opportunity to assess the effectiveness of these two different approaches, simulation versus traditional clinical skills teaching, when applied to learning the ECG within the early years of a graduate course. Once established, our aim is to evaluate a variety of different skills to assess how best to support student learning. Having the option to select approaches based on evidence from pedagogical research is critical to designing strategies that best support medical student learning.

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Developing a bespoke e-workbook

Dr Matthew F. Jacques, Dr Paul S. Harlow, & Natasha Noel-Barker

University of Nottingham, UK

Textbooks and related core reading have long been a staple tool for staff delivering a learning resource for students in higher education, providing a fundamental source of information (Waller, 2013). However, for students, staff and institutions alike, hard copy textbooks are expensive and environmentally unfriendly (Kingkade, 2013). In addition, much debate remains around the efficacy and effectiveness of textbooks in a digital age (Lynch and Ratto, 2012), with Grensing-Pophal (2010) stating "higher education must position itself to be ready to incorporate e-books effectively".

Textbooks vs e-books

Online e-books have become increasingly utilised by many UK academic libraries (Casselden and Pears, 2020); however for many staff, it can be difficult to find a single textbook of reference that encompasses content for an entire module. Students might have to access multiple textbooks/e-books for a single module, which could be confusing. Although it is common practice to direct students to various chapters from an array of books for further reading, it could be considered as passive learning. In an evolving world of interactive learning tools, flipped classrooms, team and problem-based learning, a more active and student-centred approach to learning should be considered.

How to support student learning?

Xerte is an open-source software developed at The University of Nottingham, primarily for creating interactive learning content. To date, Xerte has been primarily used in the development of single-topic learning resource (Sait and Tombs, 2021). However, it has been proposed that it could be used as an e-workbook, whereby it can be integrated within the virtual learning platform, providing a more active learning approach for students. The development of a bespoke e-workbook would allow for relevant content only to be included, avoiding potential issues surrounding access to external sites and reducing costs for students.

The development of a Xerte e-workbook allows the authors to develop written content as a resource for students, in line with their specific module content, and avoid any potential issues of multiple textbooks being used or potential student expenses. In addition, along with core written content, the Xerte package allows the development of multiple choice questions, problem-based learning, and even allows students to write and view model answers; these are just a few of the benefits. The use of these interactive activities means that real-time information related to students' knowledge, or skill-set, can be monitored, and feed-forward in to future teaching. Furthermore, higher level skills can also be developed by an e-workbook by directing students to specific journal articles with instructions related to reporting findings or mechanistic explanations.

Evaluating students' perceptions

We are currently undertaking a pedagogical research study to evaluate student perceptions, engagement and effectiveness of an e-workbook. Students completed the first half of the academic year with no e-workbook available to them, acting as a control condition. In the second half of the academic year, all students were given access to an e-workbook, which has been integrated into the virtual learning platform with specific content placed next to lecture content. Students' exam performance, engagement and perceptions of the E-Workbook are all being used to assess its use.

Thus far, students have anecdotally reported enjoying the use of the e-workbook, identifying its interactive features, directed learning and placement within the virtual learning platform as key benefits. We look forward to further exploring the impact of this approach and how it could support student learning.

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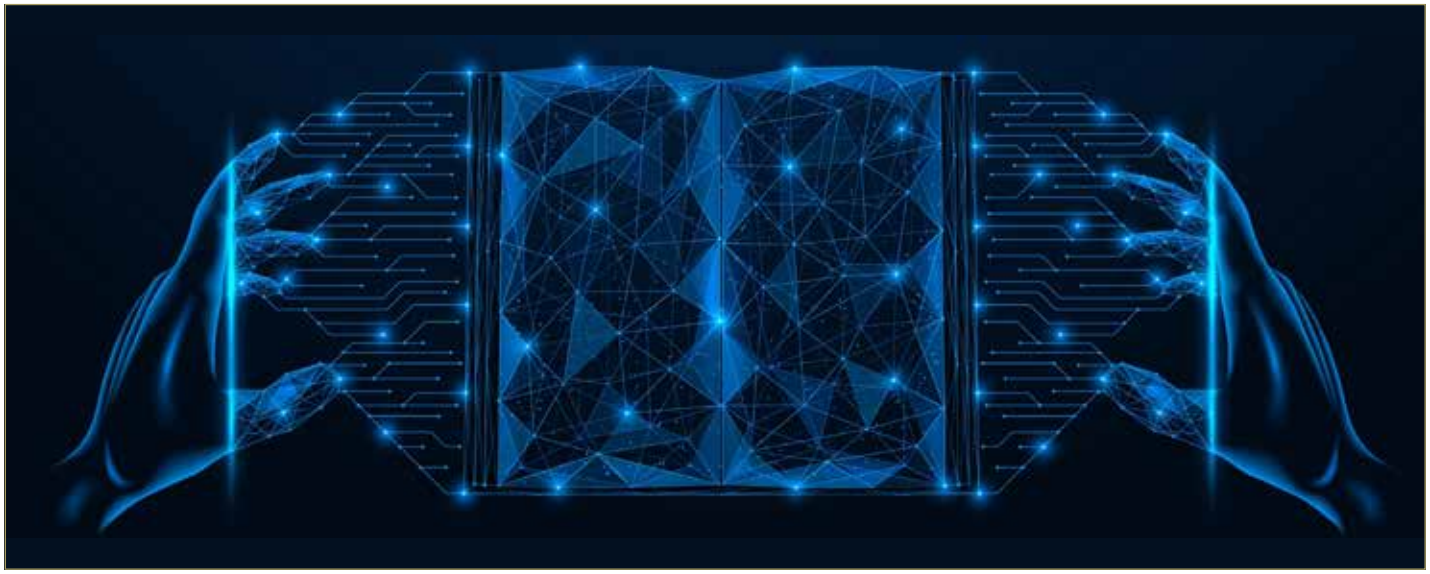

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Do bears poop in the woods?

Developing an inclusive workshop to support understanding of critical analysis

Dr Jenny Moran

Keele University, UK

It should not perhaps have been such a surprise to hear the "thing" my final-year students would have really liked me to go through in a spare workshop slot was 'what do we mean by critical analysis?'. It was apparent that despite efforts in various forms, across different modules and year groups, our often-extensive feedback was still not quite hitting the spot. There was a gap between what we as academics meant by the term "critical analysis", our feedback surrounding it, and how students received and understood that feedback.

This caused me to reflect upon my own understanding of and ability to communicate the term. What do I want and expect to see within a discussion section? It still felt a little "I know it when I see it" but this is not helpful to students who are desperate to know what "it" is. The challenge was to clearly define what we expect/hope to see, and how we can convey that to students in a way that is accessible, and that they can and will engage with. Something that removes the fear and mental blocks affecting understanding of the task.

Identifying the block

I decided to try another approach within this session. Perhaps it was the science itself that created the block, preventing students from engaging and discussing their thoughts? The fear of being wrong and saying something daft stifled genuine debate within the group, and this session risked being no different. They knew they didn't understand, I knew they didn't understand, but nobody would say it out loud. I thought I would try to lighten it up, make them laugh and relax enough to remove the threat and make it more fun, hence the title "Do bears poop in the woods?"

This is the sanitised title, not the actual one used within the workshop. That one was the more familiar, original phrase, and it had both shock (I said a swear word) and humour on its side. It was a phrase I was very familiar with and assumed students would be too. I soon realised, initially at least, they had no idea what I was talking about. It would seem only three out of 100+ students had heard the phrase before, with most looking mystified at best. However, this turned out to be a great ice breaker, they were now laughing at and with me, and were happy to give it a go.

Removing the fear factor

Before the big title unveil, I introduced critical analysis and we had a limited discussion surrounding previous feedback received and what they thought it meant. I explained how we often see lots of description of results within a discussion but little analysis. Still the "analysis" word though, what did I mean by it? What did I expect to see? How should/could they be critical? Having reviewed the gap between what I think my feedback means and what they think my feedback means, I launched the bears.

I introduced the title and explained that we were going to look deeper at the day's burning question "Do bears poop in the woods?" including some memes, tongue-in-cheek newspaper articles and made-up data to support the task. I introduced the various sources of "evidence" and students began to talk between themselves about what they thought the answer was. The removal of risk lightened the workshop, there was no fear of getting the wrong answer. As there wasn't really a right one anyway, they just explored the topic from all angles.

Padlet was used to capture and share their thoughts, and to help prompt greater thinking and discussion around the subject (Fig.1). They considered bear location; did they live in the woods? What about paths, grassland

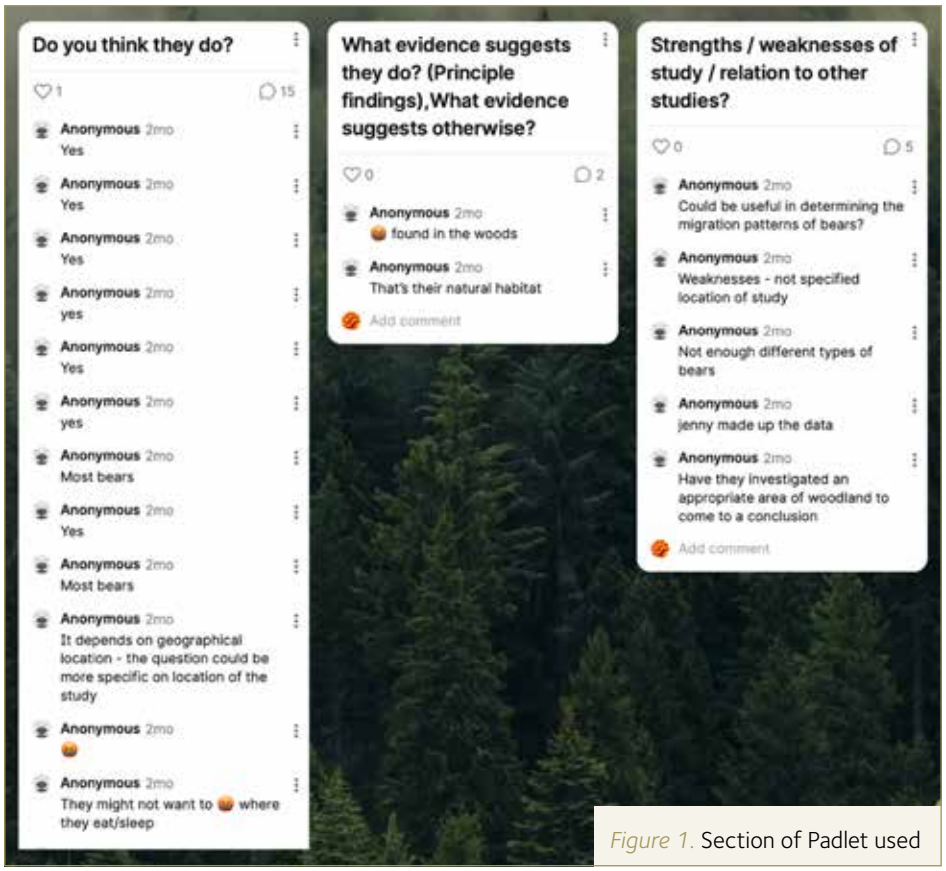

Figure 1. Section of Padlet used

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surrounding the woods, caves? Did bears get up in the night to return to the woods or poop in their cave? Did time of year affect them, was hibernating or mating season a factor? We looked at the sources of evidence supplied and began to evaluate their credibility, methodology, and quality of data. Students looked at my data and offered their thoughts regarding the rigour of my methods and the strengths and weaknesses of it and other evidence.

Boosting students' confidence

We had fun, students discussed openly and had confidence to either shout out suggestions/thoughts or put them on the Padlet. The session helped them look at sources of information and data more critically, to evaluate if something earned "weight" within an argument, and how they could reflect this within their discussions.

Following the warm-up exercise we revisited a second-year lab report previously completed and considered an earlier cohort's anonymised discussion sections. We pointed out good and less good parts, which examples were more descriptive, which began to analyse the data, and which were exemplary. Students happily critiqued the work and could demonstrate that they understood the feedback received and had a better understanding of what critical analysis looked like when done well.

In conclusion, introducing a low-risk, fun activity allowed students to openly discuss and explore a question, critically interpreting both data and supportive literature with a greater level of confidence and ability.

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Using AI to develop transferable skills*

Dr Dawn Davies

Associate Professor, School of Physiology, Pharmacology and Neuroscience, University of Bristol, UK

The potential for artificial intelligence (AI)-generated answers submitted by students for assessment has created a lot of anxiety within the academic community. When ChatGPT was released at the end of 2022 we started to see many articles in the educational media stating that it was the end of assessment in higher education as we know it and that we must rethink the way that we assess students (Bagshaw, 2022).

The challenges of AI to student assessment

There is no doubt that AI, such as ChatGPT, poses a challenge to assessment for and of learning and that it will become more sophisticated with time. Currently, our own testing of ChatGPT suggests that it is good but not great at answering with the combination of breadth, depth and critical awareness that we look for in good answers to essay questions. But even as I write this, I know that there will be more iterations with greater ability to approach complexity by the time this is published.

Rethinking assessments

However, as the initial panic subsides, it is clear that AI offers opportunities to rethink assessments (Chowdhury and Wamba, 2023). But what are these opportunities and how do we turn them into sustainable activities for our students? One potential route is to use AI output to focus on reliability of sources and critical evaluation and thereby support the development of transferrable skills in our students. In a world of information overload, it is crucial to teach students at the earliest opportunity about reliable sources and in doing so help them to think critically about the information they are gathering (Wiley *et al.*, 2009).

What is a reliable source?

Currently, we know that AI-generated content can be unreliable, containing significant inaccuracies and can create false references (Lo, 2023). This provides a topical and relevant platform for engaging students in the use of reliable sources and general fact checking. As an example, we are in the process of developing an activity aimed at first-year students where students assess the validity of a piece of writing that has been generated by AI.

In this case, we are focusing on two factors. Firstly, factual accuracy. Is the piece accurate overall and does it contain any specific factual inaccuracies? Here we engage students with the concept of reliable sources of information and how to fact check. Secondly, validity of any references cited. Can the students find the reference, is it the correct reference for the topic and can they find the information within the reference that is being stated in the piece? In this way we are encouraging students to engage with the primary literature in a structured way early in their programme. They are directed to find a specific paper and to look for specific content. This activity also highlights the limitations of AI. It strikes a note of caution for students regarding factual inaccuracies and irrelevant or even non-existent references that occur in AI-generated text, hopefully discouraging the wholesale outsourcing of their intellectual effort to AI.

Regardless of how much we are required to rethink our assessments to ensure that they remain relevant and robust in the age of AI, it is vital that we bear in mind that our graduates will be entering into a world of employment where these tools are widely used. It should be part of our role as educators to equip them to use AI effectively and to demonstrate the added value that they can deliver. It is important now that we engage with AI, assess how it can support education including skills development and disseminate what works and what doesn't work within the education community.

*No AI was used in generating this article, it's all my own work!

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Transdisciplinary science and art

How drawing and notebook creation improved student accessibility to complex scientific concepts

Dr Francesca Arrigoni

Kingston University, UK

Dr Francesca Arrigoni is an Associate Professor in Physiology and Pharmacology, her research specialising in vascular disease associated with infection.

In a bid to improve student motivation, resilience and confidence, her innovative practice promoting critical and creative thinking led to her nomination for a National Teaching Fellowship.

"Hands up, who hates drawing?" seems a reasonable question to ask pharmacy students just before embarking on a transdisciplinary Science and Art lesson. Unsure of what trauma science students must have experienced in their previous education for a few to raise their hands, I remain hopeful, as it's never quite as bad as the visceral reactions from some art lecturers when asked, "Who enjoys maths?"

As an educator I don't think that these disciplines are mutually exclusive. Whilst science makes sense of the world and converts the things that we see around us into knowledge, art takes our perceptions and questions them. There is an iterative process at work, where without our perceptions and the questioning of our perceptions, science would not have such a rich foundation to build upon. Science is a creative process. It is known that most science Nobel Prize winners practice art in some form (Root-Bernstein and Root-Bernstein, 2023).

The cost of moving from analogue to digital learning

As we increasingly move into a digital age and AI, as hard copies of textbooks move into an online format, those analogue skills in university courses such as note taking and drawing become sidelined and students lose essential practical skills.

For pharmacy students to engage with the lists of information they must learn and to make the learning process less passive and didactic, we deliver flipped lectures, workshops, and tutorials to enable students to be present in the moment and enjoy the subject. However, a triumvirate of circumstances that include teaching a core subject such as physiology integrated into another course, the attainment gap and information-rich syllabuses means even these approaches to teaching may not be as effective in engaging students (Lujan and DiCarlo, 2006).

While it is recognised that students have come to university to appreciate our expertise and to be immersed in university life, for many the realities are that they will be commuting, they may have jobs and they may have dependents and/or small children. They will bring different skills and experiences to the table, but this may come at a cost of engagement and deeper learning.

STEAM

Students who will work competitively in a global market need to acquire those deeper learning skills to enable them to succeed and thrive, some of which have been deconstructed into critical and creative thinking. A delightful acronym of STEAM, Science, Technology, Engineering, Art and Maths, is gaining traction and many find their teaching increasingly utilising it to address those skills (Perales and Aróstegui, 2021).

In the Department of Pharmacy at Kingston University, an online drawing class was created to supplement a dissection practical during the pandemic, which could enable students to

Figure 1. Students examining some of the artefacts at the Economic Botany Collection at the Royal Botanic Gardens, Kew. In this image *Papaver somniferum*/Opium. Photograph Clare Conway (CC BY-NC-SA 4.0)

spend time closely observing the heart. This fine art approach to cardiac physiology led to improved essay results for those students who engaged (Arrigoni, 2021). Over time, as popularity grew and nursing and midwifery courses across the faculty took up the online course, the content expanded to include instruction for drawing gross and detailed kidney anatomy with videos created to support those students who were on placements.

In 2022, art-physiology was finally taught face to face, embedded into a now award-winning nursing elective. Having successfully taught nursing students complex cardiac physiology and visual thinking using art (Blackie *et al.,* 2023), it was clear that the process of drawing had enabled students to voluntarily work outside the hours of the class, helping them learn independently.

The next step was to equip students with a skill set to induce curiosity, scientifically observe, and voluntarily question.

The Pharmacognosy of Poisons

Collaborations with Kingston School of Art increased the ability to work in an outward-facing fashion, and an exciting title of a short pilot course was created, "The Pharmacognosy of Poisons", based on the Economic Botany Collection at the Royal Botanic Gardens, Kew. To recruit students, posters were put up before lectures in which students were told about the course, that botanical art was involved and that there would be a field trip to the Royal Botanic Gardens, Kew. Eight students signed up.

Figure 2. Working on notebooks meant that the aesthetic appeal could be given equal weighting to the scientific content. Photograph Clare Conway (CC BY-NC-SA 4.0)

The Economic Botany Collection

The Economic Botany Collection at the Royal Botanic Gardens, Kew is an extraordinary range of artefacts, all derived from specimens collected through global partnerships. These artefacts all contain a narrative with a particular emphasis on regions affected by British colonialism or trade.

Plants were chosen that were both available from the Economic Botany Collection and that would align with the student curriculum, *Abrus Precatorius*/(Rosary pea) seeds, *Chondrodendron tomentosum*/Curare d-tubocurarine, *Illicium verum*/Star Anise, and *Papaver somniferum*/Opium (Fig.1).

Nature journalling

Students were provided with drawing equipment, taught botanical art, how to draw accurately, draughtmanship of their images and the lifecycles of the plants alongside elementary botany and plant structure/function. They then learnt how to create a nature journalling notebook, promoting a creative approach to critical thinking. It was composed of three steps: close observation, questioning the observation and asking yourself "why?" It creates links between observations and thoughts (Laws 2020) (Fig.2).

Embedding transdisciplinary content into a course can improve both student and teaching experiences

Positive results from test scores and the feedback from the questionnaires (Table 1), demonstrated the positive impact on both knowledge uptake and accessibility to the subjects while the notebooks the students had created were an easy way to assess their engagement and understanding.

Feedback from all students was overwhelmingly positive. This provided evidence that it was possible to embed transdisciplinary content into a course and improve both student and teaching experiences, during which students could acquire creative and critical thinking skills and a deeper understanding of the subject they were studying (Balemans *et al.,* 2016).

Interestingly, as the week progressed the students' confidence grew in the tasks that they were undertaking, and they became more motivated. With this new-found motivation, they had agency to make decisions of how they wanted to progress with their studies of the plants and their pharmacology, reflected in their work and feedback (Fig.3). Recreating this level of positive feedback in a laboratory setting may take days or even weeks, at great expense.

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The next steps

Artwork is very accessible as a discipline and can be a means of improved physical observation, increased tolerance for ambiguity, and increased interest in communication skills (Klugman and Beckmann-Mendez, 2015). This study and others have increasingly demonstrated the positive impact that such a simple technique can have in lowering barriers to science education and learning to anyone. Preconceptions and negative expectations appear to be the biggest obstructions to students and staff engaging with art as a learning and teaching tool. The next steps will be removing these barriers by increasing the visibility of transdisciplinary science and art successes.

Acknowledgements

I would like to thank Clare Conway, Kingston School of Art for collating the student images and Erin Messenger, from the Economic Botany Collection, Royal Botanical Gardens, Kew.

Student responses to: "Was this course what you thought it was?"
No, I thought it was only study of medicinal drugs but it was more than that.
No. I thought that it would be more based on learning from PowerPoint slides with a little bit of art on the side but it was surrounding using art to learn.
No, I thought it would be bit of drawing and a little bit of how plants can be used as. Honestly much better than I thought.
Yes. It was full of fun and the best way to spend the reading week, it was interactive and colourful as I thought. Thank you.
No , I learned more skills eg drawing and explored other plants and poisons. It was an adventure and way more fun.
I thought it would be just poison things but with the art, it was fun and more appealing.

Table 1: Student responses at the end of the five-day course studying pharmacognosy.

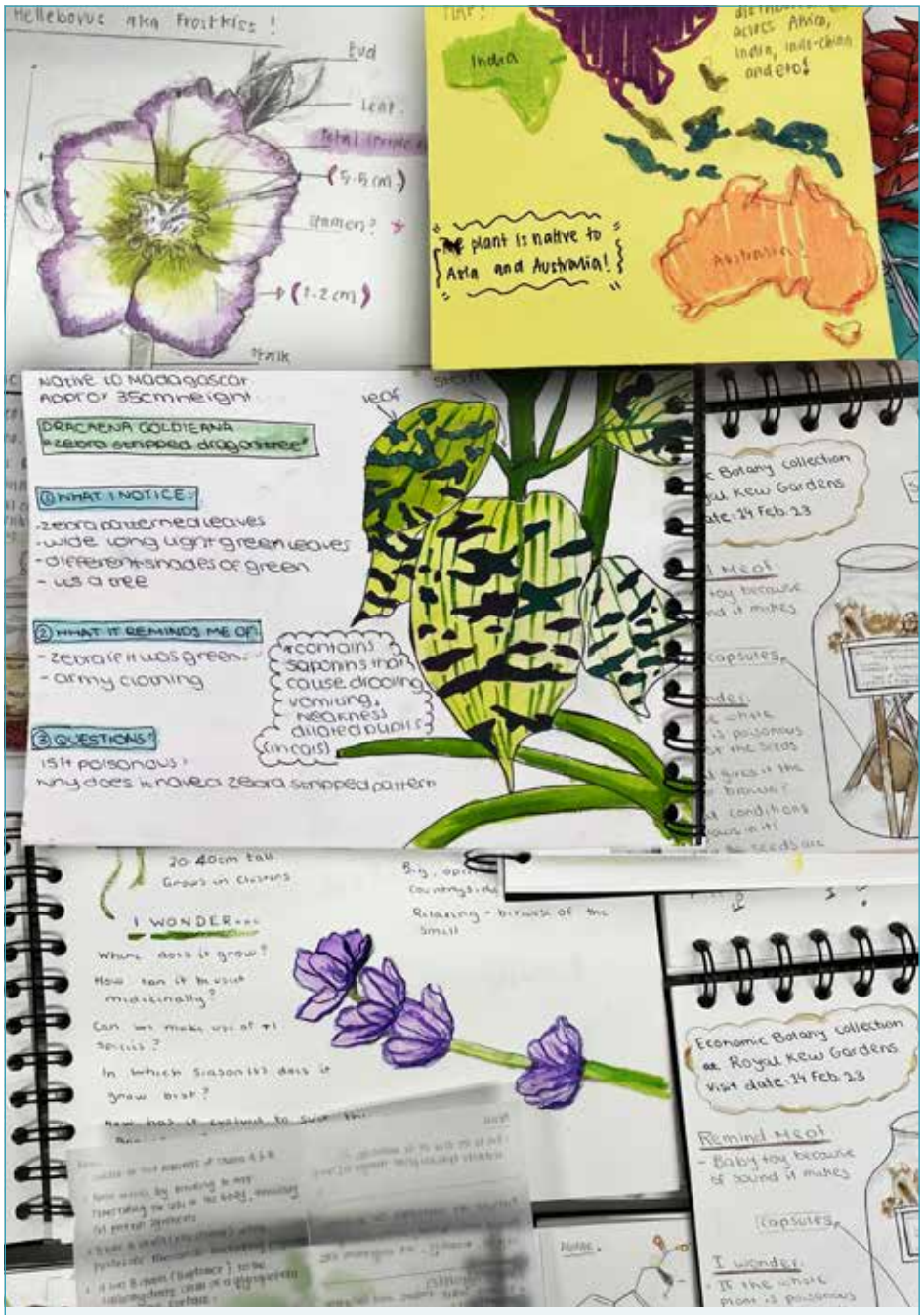

Figure 3. Collage of student work examining numerous plants the students had independently studied at Royal Botanic Gardens, Kew. Image Clare Conway (CC BY-NC-SA 4.0)

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Pandemic positives

Replicating the online chatbox in the physical classroom

Professor Louise Robson

School of Biosciences, University of Sheffield, UK

During the COVID-19 pandemic we had to pivot our lecture classes online, using a range of approaches to teach and engage with our students, including platforms such as Blackboard Collaborate, Microsoft Teams and Zoom. These platforms all had a chatbox for students to ask questions, and ask questions they certainly did. I had way more questions than I ever had in my classroom sessions, and students clearly valued the opportunity for feedback.

As I pivoted back to face-to-face teaching at the start of the 2021/22 academic year, I wanted to replicate the chatbox in my physical classroom. To do this I enabled the question tool in Encore (our Echo360-based lecture capture platform), and ended up with several hundred questions being asked over the year. Students told me they valued being able to ask questions and get feedback, but they also valued listening to answers to questions other students had asked as well. Providing the in-class chatbox allows me to provide a low-risk and supportive environment for students, and provides additional synchronous communication within the classroom, helping develop the learning community.

The pandemic chatbox

I teach large physiology classes, so during the COVID-19 pandemic I had to pivot my teaching online (we didn't have a lecture theatre large enough due to social distancing). I took a blended approach, flipping content-based sessions into chunked video recordings, and running active learning sessions online using Blackboard Collaborate. This allowed my students to study content asynchronously, with synchronous active learning sessions consolidating their knowledge and understanding. During the online sessions I used the Collaborate chatbox in a number of different ways. The first was to help provide an informal learning environment. I would start each session with everyone posting their favourite emoji, and I used emojis to "sense" the room, e.g. asking about their confidence levels in a topic using the thumbs up or down emojis (Fig.1). I also encouraged students to use the chatbox to post questions, so that I could provide additional feedback and guidance for their learning, and asked students to type answers to questions as well (peer-to-peer support). Over the 2020/21 academic year I had hundreds of posts and questions, and in my final online session I asked the students (using a poll) whether they valued being able to type questions. 100% of those who responded said yes! It is rare to have something so universally valued by students, so for me this was a strong indication that being able to type questions was something to implement as I returned to the physical classroom.

The classroom chatbox

That return to teaching on campus was (for me) the 2021/22 academic year, with teaching essentially "back to normal". However, I felt that it was critically important

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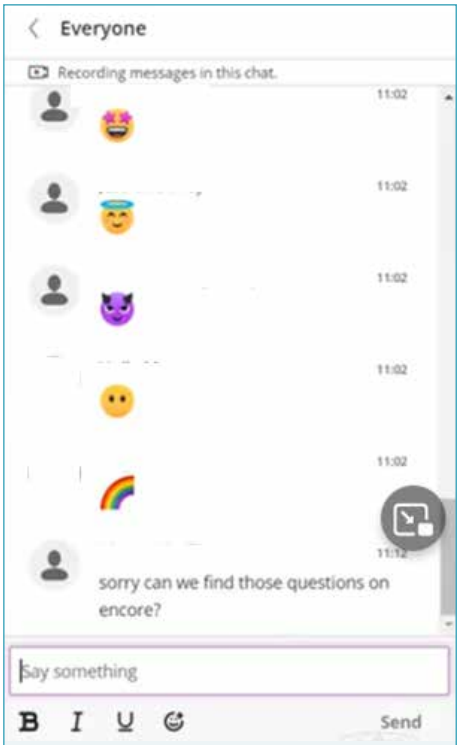

Figure 1. Anonymised screenshot of the online chatbox showing the use of emojis.

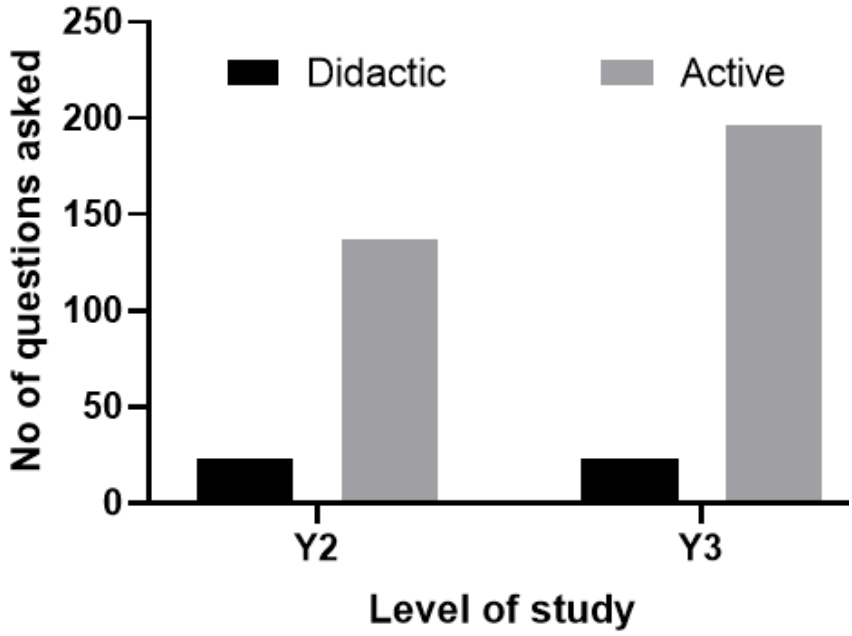

Figure 2. Analytics data on the number of questions asked across didactic and active learning sessions, and across second- and third-year cohorts.

to retain those aspects of the online pivot that could enhance the learning of my students. I retained some of my flipped recordings, and delivered a mixture of didactic lectures and active learning sessions in the classroom. I also enabled the question tool in our Encore system. Encore is our Echo360 lecture capture platform, but it's actually so much more than recording live lectures. I upload my Powerpoint slides into the system, and deliver my lectures from within Encore. This allows me to embed polling slides into my lecture, something that is particularly important in my active learning sessions, as it provides a low-risk environment for students to answer questions. I can also give feedback on answers as well (good points and areas for improvement). Turning on the question tool also allowed the students to ask me questions while in the classroom, just like in the online sessions.

Overall I had several hundred questions posted over the year, with between 11% to 22% of students on my modules asking questions (Fig.2). I observed more questions being posted in active learning sessions than in didactic classes, but this was a consequence of my expectation (setting less time to review and answer questions at the end of a traditional lecture), and also that students liked having time to assimilate their learning before framing their questions.

"...when I go back to the lecture content ... that's when I identify my gaps and have questions to ask"

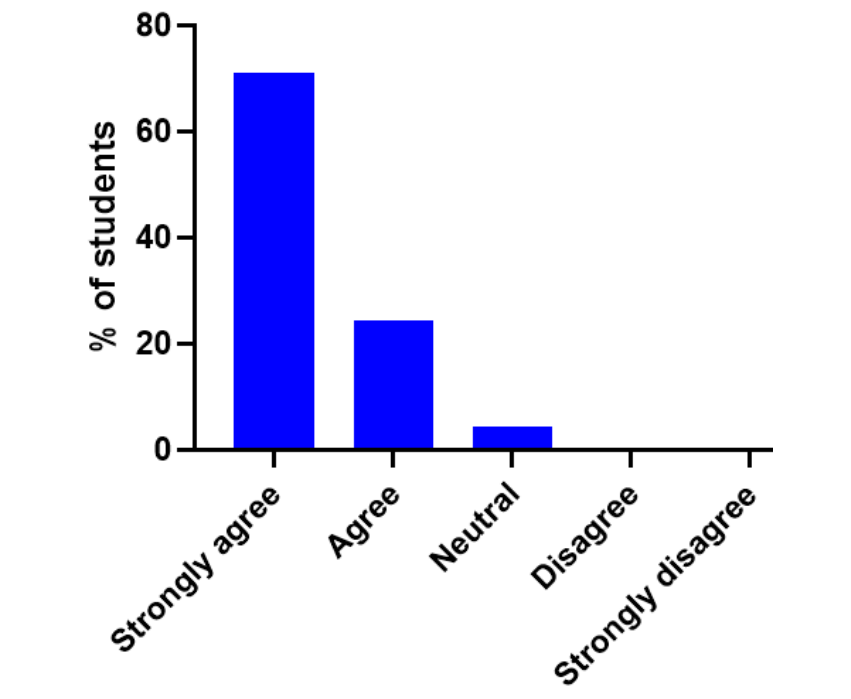

Figure 3. Bar chart showing student responses to the statement "It was helpful for my understanding and learning to be able to listen to answers to questions posted in class, even if these questions were not posted by me".

What do students think?

To evaluate the question tool value, I started by asking students how they liked to ask questions, and unsurprisingly 92% of students stated that they preferred to type questions (with the remaining 8% saying they prefer not to). Not a single student selected the option to ask a question verbally in class.

"Inner barrier to ask a question is much lower when you can type a question and post it anonymously"

"I feel more confident being able to type my questions as I feel it gives me longer/more thinking time to really refine the question".

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"Providing an in-class chatbox has enhanced my support for student learning. It provides additional guidance, feedback and support for students, and allows them to ask the questions they want to, but might be too shy to actually ask."

Accessibility theme	Learning theme
Anonymous, personal, can access afterwards, student friendly, reduces anxiety, Q asking accessible to all (even shy students), helps the whole class, easy to access, can "hear" questions more clearly.	Others think in a different way, which helps other students learn, encourages attendance, leads to a constructive dialogue between staff and students, instant feedback, solidifies and consolidates understanding, reinforces learning, helps them see the areas they don't understand, clears confusion.

Table 1: Accessibility and learning themes.

67% of students strongly agreed or agreed it was useful being able to post questions in a didactic lecture. This rose to 83% when they were asked about posting questions in active learning sessions. Interestingly, only 48% percent of the students had actually posted questions themselves.

Students also valued the opportunity to listen to answers to questions posted by other students, with 71% of students strongly agreeing it was helpful for their understanding and learning to be able to listen to answers to questions posted in class, even if these questions were not posted by them (Fig.3).

I also undertook a thematic analysis of free-text comments, and these could be subdivided in two main themes: accessibility and learning (Table 1). For me these comments highlighted that the chatbox provided a supportive and inclusive learning environment for all of my students.

Overall, providing an in-class chatbox has enhanced my support for student learning. It provides additional guidance, feedback and support for students, and allows them to ask the questions they want to, but might be too shy to actually ask. It has transformed my active learning sessions, which are now even more interactive, because we are all able to ask each other questions. It's challenging for me (I don't always have the answers), but I love that my students have an opportunity for synchronous communication. This is something we identified as being important during the pandemic (Nordmann *et al.*, 2020), but actually, it's something we should be providing in the physical classroom as well.

Interested in using an in-class chatbox? Here are my top tips

1. Set expectations about when you will look at questions in a session - there are differences in my approach in didactic versus active learning sessions.
2. Set expectations around asynchronous questions - the question tool is only (in my sessions) for during class.
3. Clearly articulate these expectations in the handbook (and make sure students have guidance on the technical aspects of using your question tool).
4. If you have questions but have run out of time, consider posting the questions and answers on your discussion board (and remember an answer doesn't have to be typed, I often make videos of answers).
5. Don't be afraid to say actually, I don't have the answer to that question. Let me go away and do some reading and I will get back to you on the discussion forum.
6. I find it helps to have two computers. The desktop computer is used for the lecture (it's on the main screen). I open the question platform on my laptop. Remember, if students are posting questions it also means they can see them on their own laptops/devices as well.

If you want to find out more, just email me at **l.robson@sheffield.ac.uk**

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"Sounding out the students" ultrasound in undergraduate anatomy education

Overcoming barriers to ensure a positive ultrasound learning experience

Dr Keren Bielby-Clarke

University of Bradford, UK

Dr Pip Garner

University of Bradford, UK

The use of portable, handheld ultrasound equipment is increasing in the teaching of clinical skills across a wide range of different undergraduate programmes. This provides flexibility to demonstrate the essential principles of ultrasound in a much wider range of situations than traditional clinical devices. There are clear benefits for undergraduate students, ranging from the hands-on application of anatomical knowledge, development of professional skills in communicating and working directly with patients, and clinical skills in terms of the use and interpretation of the ultrasound scans. However, if unrecognised, cultural, social and personal barriers may negatively impact students' access to these opportunities.

Introducing ultrasound into anatomy teaching

In the spring/summer of 2022, we received funding for three handheld ultrasound probes, and so began a project to integrate hands-on ultrasound sessions in the Clinical Sciences programme at the University of Bradford (Edwards et al., 2023).

This was a perfect opportunity to enhance our provision of patient-facing clinical skills training, as a simultaneous programme restructure meant that new modules were created with a stronger anatomy theme alongside an increased focus on medical imaging. The programme is designed to provide our graduates with a strong science background alongside the personal and professional skills necessary for a wide range of patient-facing healthcare professions. Therefore, the use of ultrasound was seen as an exciting opportunity to engage students directly with volunteer "patients", while simultaneously enhancing their direct application of anatomical knowledge.

The University of Bradford is unusual in its diversity, with a population of ~70% BAME students (Advanced HE Race Equality Charter) While this diversity and range of cultures, backgrounds and beliefs is certainly a strength, it can also present challenges when students are expected to interact with each other and with patients to undertake physical examinations or to explore living anatomy and clinical imaging. For example, performance anxiety may occur when carrying out clinical examinations with a group of peers.

Cultural or religious beliefs may restrict the study of the human body in specific circumstances, with physical contact being perceived as discouraged or even forbidden. Personal experiences may also dictate a student's engagement with (for example) a patient of the opposite sex. It is therefore essential to identify and recognise possible barriers, mitigating them wherever possible, to allow students to maximise these learning opportunities.

Integrating ultrasound

Ultrasound sessions were directly integrated into taught practical sessions to provide opportunities for direct application of anatomical knowledge, in topics such as thoracic, abdominal or pelvic anatomy, the upper and lower limbs, and the back. In planning the sessions, careful consideration was given to the comfort of the patient and students, while maximising group throughput (due to limited practical time available in the timetable, coupled with large cohorts of students). Students were provided with instructions in a worksheet and supported by an academic or a trained demonstrator while carrying out the ultrasound.

From the outset our students demonstrated a wide range of confidence levels and engagement, with some eager to interact with the patient and use the ultrasound, and others remaining distant and silently observing. There are many reasons why students may not engage. We started the sessions early in the academic year, so the students were acclimatising to the course and to each other, and for many of them this would also have been their first experience interacting directly with a patient. For others there may have been other underlying concerns. This evaluation was designed to identify and where possible attenuate these barriers to future experiences.

How do we know what we don't know?

Informal focus groups were set up to gather opinions and feedback from students across the different cohorts. These groups comprised a maximum of five students per group with one member of staff. They consisted of a directed but informal discussion around specific issues and challenges, as well as positive experiences, when using the ultrasound equipment to work with patients. Since the ultrasound was used in different ways and to different extents across the years of the programme, volunteers were sought from the foundation, first and second year separately.

Within the groups, the main focus of the discussion was to identify any specific benefits that the students noted, or barriers to the use of the ultrasound equipment when interacting with patients in this quasi-clinical setting. The questions to guide the discussion included:

- *What were your feelings before, during and after the ultrasound session?*
- *Were there any barriers to you taking part or conducting an ultrasound examination?*
- *What could we have done differently to prepare you?*
- *Was the experience worthwhile?*
- *How will you approach similar sessions in the future?*

These questions were chosen to encourage the students to reflect on their experiences, highlighting what they gained from it as well as any specific issues, and identifying future solutions that may ease the process.

Ultrasound "is a privilege" – but group size is a drawback

Within the focus groups, students were very positive about the overall experience. They highlighted the benefits of applying their taught anatomy knowledge to the real-life patient, exploring the different structures and seeing the actual positions and locations.

"I think an ultrasound is a privilege because you could have just given us images of X-rays"

Large group size is a well-recognised barrier to effective engagement in practical situations such as these, requiring a level of confidence that cannot be assumed, particularly for students in the early stages of their degree. Group size was highlighted by a number of students as a major barrier to engagement, as many did not feel comfortable "performing" in front of their peers. Careful consideration in the future and practice in a low-stakes environment (without a patient) may remove this obstacle. However, working in larger groups allows more reticent students with anxiety around patient interactions to act initially as a bystander to develop their levels of comfort, while the more confident students take the lead.

Surprisingly, when discussing and consolidating the experience there is an almost competitive aspect in terms of locating and identifying the anatomical structures.

"We discussed our findings. Oh, I found this. Did you find that? I saw the striations. Did you? I found a bit of the liver."

In this way the larger groups enable interaction and engagement even after the session.

It became very clear that there was not enough preparation beforehand in terms of actually using the probe, or interpreting the images in terms of specific anatomical structures and landmarks. However, the presence of the academic demonstrator to guide and question students during the activity was useful to direct attention and check understanding.

Prior notice: preparation is vital

Some of the students reported being "surprised" that they would be working with a patient. However, they then viewed this as a rewarding and useful experience, allowing

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Figure 1. Students using the probe at the University of Bradford, UK. Photo by the University of Bradford.

them to interact with individuals in a quasi-professional setting. We also had students who reported feeling under-prepared in terms of how to address and speak to a patient, and how to actually use the ultrasound; for example, there were concerns about causing discomfort by pressing too hard with the ultrasound probe.

"I tried to talk, but I didn't know what to say and it was a bit awkward. So I didn't."

When students are given prior notice of the patient and anatomical areas to be studied, they have time to prepare mentally and also to rehearse professional skills such as basic communication. Simply "dropping" students into a session with no prior warning may leave them uncomfortable and with difficulties engaging. Students would therefore benefit if provided with specific guidance on patient communication, in order for them to become comfortable with their role as a healthcare professional beforehand.

Likewise, examination of a patient's abdomen or pelvis may require more consideration beforehand, compared to the arm or hand, due to generalised cultural significance of the viewing or uncovering of body regions normally not visible.

Recognising and clarifying religious and cultural barriers

In terms of the cultural or social barriers, there were several different issues highlighted. Alongside the expected gender-based tentativeness (particularly when examining areas of the body that would normally be covered, for example the abdomen or pelvis) there were areas of concern around physically touching another individual's skin, or of discomfort when exposing parts of the body to colleagues when working in student groups. It was mentioned several times that students were initially concerned about working with a male or female patient particularly, but then realised that in practice, they would be dealing with all patients and so this was a valuable learning experience.

"We saw that there was the patient and it was like, Oh, okay, there's a patient there. And then the more you thought about it, the more you realise, hang on, that's what we're going to have to do in the healthcare setting anyway."

Significant and specific religious barriers were also identified. In culturally diverse cohorts this can often be an unseen or unrecognised issue, particularly when there is a "mismatch" in student and lecturer demographic, in terms of religion, race or background. Students reported taking it upon themselves to consult religious scholars, in order to confirm that they were permitted to undertake clinical interactions of this nature, given the educational/professional setting and training.

In future, consultation with appropriate religious scholars and faith advisors will be undertaken by academics, ensuring that any student concerns can be answered quickly and effectively to reassure students and remove any perception of impropriety.

"Failing to prepare is preparing to fail"

Thorough preparation cannot be too highly valued, as this avoids time wasted in the ultrasound session and allows students to maximise the engagement with their patient. To this end, carefully structured resources to allow students to check their anatomical knowledge of the region to be examined and explore example ultrasound images to prepare for the practical session will be essential. It is also important to consider the effective timing of the release of these resources, long enough before the session that students have time to engage and explore them, but not so far in advance that they are forgotten by the session itself.

"I think maybe if you had videos showing how to do each ultrasound prior to your session, people would be more comfortable with doing it"

"Having that prior knowledge would help in this session because I'll know what to look for and be like, Oh, this is how I do it".

So what's next?

The main focus of this evaluation was to ensure that students felt prepared and comfortable prior to their interactions with patients, allaying concerns both from a personal and professional perspective, and in terms of their knowledge.

We have identified several points for improvement and clarification, both for provision of information and preparation, but also for guiding and directing our students to specific points of consideration that they may not have otherwise appreciated.

Moving forward, these improvements and additions will enable us to create a safe and engaging space where students can interact and learn without fear of judgement.

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Advanced HE Race Equality Charter: University of Bradford (Bronze Award)

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Team-based learning

Could it be an effective strategy for teaching physiology to preclinical medical students?

Dr Aamir Magzoub

Associate Professor of Physiology
Department of Physiology,
College of Medicine, Najran University,
Kingdom of Saudi Arabia

Team-based learning (TBL) is a student-centred and instructor-directed teaching strategy for small-group active learning. TBL enables students to apply conceptual knowledge through a sequence of events, including individual work, teamwork, and immediate feedback. The TBL approach underpins group learning and has many proven advantages for the students in terms of knowledge, skills, and attitude domains (Sharma *et al.*, 2017; Kibble *et al.*, 2016; Allen *et al.*, 2013).

Launching the TBL teaching strategy

In alignment with the new trend in medical education to shift from teacher-centred to student-centred education and early exposure of medical students to the clinical setting, we decided to introduce the TBL strategy for physiology teaching at the College of Medicine, Najran University, Saudi Arabia in the academic year 2019-2020.

The TBL strategy was chosen specifically because of the previously mentioned benefits for students. TBL also has benefits for both the TBL instructors and the college: it provides motivation and a greater opportunity for instructors to interact with students, particularly in large class settings (as opposed to passive one-way lectures), more reflection, immediate feedback, and high satisfaction for achieving of the learning objectives. For the college, TBL requires no extra facilities, and only one staff member can conduct the TBL session for all TBL groups in one classroom.

We started by interactive training workshops on the TBL for both the faculty and the preclinical phase medical students. TBL physiology topics were prepared by the physiology department, approved by the medical education department, and then injected into the course specifications of the preclinical phase courses. A TBL practical guide was distributed to facilitate easy application of the new teaching strategy, and a student feedback questionnaire was prepared for evaluation of the students' perception of TBL.

TBL process

TBL is implemented in three phases: preclass preparation, in-class readiness assurance, and the application of course concepts (Table 1). In the preclass phase (phase I), students receive suitable learning material accompanied by learning outcomes on a specific physiology topic, e.g. cardiac cycle and heart murmurs. Students study the learning materials individually in preparation for the TBL in-class session.

Phase II includes an individual readiness assurance test (iRAT), team readiness assurance test (tRAT), feedback and clarification, and team appeals. The iRAT contains multiple-choice questions (MCQs) with special construction (i.e. MCQs that promote discussion, critical thinking, and teamwork). The iRAT is completed in the classroom under exam-like conditions. The tRAT is the same as the iRAT test but is discussed in groups (e.g. 5 groups for 35

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Phase I Pre-class preparation (Outclass activity)	Individual study of the learning materials (preparation for the in-class session)			
Phase II Readiness Assurance (In-class activity)	**iRAT** (individual readiness assurance test)	**tRAT** (team readiness assurance test)	Team appeals	Discussion
	Individual students take a short MCQs test	Students retake the same iRAT with one immediate feedback answer sheet	Student teams submit written appeals to the tRAT items	Class discussion and clarification of any remaining unclear concepts
Phase III Application Assignments (In-class activity)	Student teams take challenging assignments that require collaboration of the whole team members to apply key concepts. Criteria: **S**ignificant real-life problems; **S**ame problem for all; **S**pecific choice; Simultaneous reporting (**4S**s).			

Table 1. Summary of the team-based learning process.

students' cohort). In the same classroom, students arrange themselves in teams, however is comfortable for them. The group members are known before the in-class TBL session, i.e. determined by the staff at the start of the course. The students receive the tRAT with ONE answer sheet. They go over the test items and come up with ONE key answer for each item question. An immediate feedback answer sheet (IF-AT) is used to improve group dynamics, group discussion, and item responses by providing immediate feedback that assesses their knowledge. Students scratch off a thin opaque covering to show their agreed-upon answer choice (A, B, C, D, or E) for each question in the IF-AT. The correct answer reveals a star under the scratched choice and incorrect options are blank. When students get a blank response, they go back and discuss the question again until they agree on a new option. The score awarded in each question is determined by the number of attempts taken to reveal the star. Furthermore, the instructor provides feedback and clarifies any ambiguities regarding the tRAT. At this stage of phase two, the students have the right to appeal (in writing), but they must all agree on their appeal (i.e. a group appeal).

In phase III, students receive group assignments in the form of real-life case scenarios they will encounter in the clinical stage to integrate the pre-learned knowledge with ONE answer sheet. The application assignments follow a specific rule (Table 1). The students' group learning is evident in this phase as they discuss and analyse the case scenarios and integrate their previously learnt knowledge to solve problems. A class discussion with the TBL instructor to clarify any issues relevant to the application assignments will take place once more.

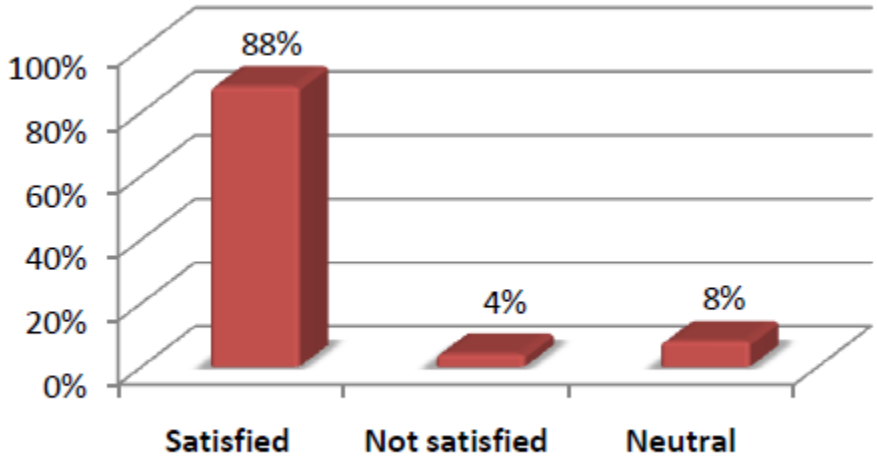

Figure 1. Student's satisfaction on covering the learning outcomes using the TBL approach in the endocrine course. Academic year 2021-2022 (*n*=46 students).

Essential principles for successful TBL

The main principles for the effective working of TBL include: 1) Properly formed and managed team groups: Each team group should include 5-7 members; they should exhibit diversity in capabilities and academic levels. Team groups are assigned at the start of the semester and continue throughout to enhance team-building. 2) Student accountability: Students should be accountable for the quality of the pre-class preparation and show active engagement throughout the in-class teamwork. 3) Well-constructed assignments: Questions in the tRAT should promote discussion, active learning and follow sound question-writing techniques, e.g. questions that seek clarification, reasoning, and consequences. Team assignments should include real-life problems and should promote group cohesiveness and team-building. 4) Frequent and immediate feedback: Timely feedback by the expert instructor is crucial during group and class discussions. It enables members to quickly correct their misconceptions of the subject matter.

TBL assessment

In all programme modules that contain TBL, the TBL sessions have a 10% weight in the final summative assessment. TBL sessions are assessed through: 1) Results of the iRAT (60%), 2) Results of the tRAT (20%), and 3) Results of the application assignments (20%). Peer evaluation (5%–10%) can be included by using special methods such as Michaelsen and Fink's, in which each student rates his or her other group members based on their contribution to learning acquisition and the team performance (Michaelsen *et al.*, 2008). If peer evaluation is included, the group work (tRAT & application assignments) is worth 30%–35%.

The score from the iRAT is weighted the highest for two reasons: firstly, to encourage preparation in the pre-class phase and the mastering of the learning material; and secondly to buffer and balance the results of the tRAT and application assignment because all students in the same group receive the same mark.

TBL outcome

According to the student feedback questionnaire, most students were satisfied with the new teaching strategy with nearly similar response ratios in the various preclinical system-based courses (Fig.1). The TBL teaching strategy underpinned group learning of physiology in the preclinical phase and enhanced students' knowledge, skills, and attitude domains. In the knowledge domain, students can better retain and retrieve information; they also learned basic physiological concepts and how to apply them in case-based assignments. In the skill domain, students acquired critical thinking and reasoning; they could accomplish difficult intellectual tasks. In the attitude domain, TBL helped the development of teamwork and professionalism. The TBL results were consistent with the other summative assessment tools. The TBL instructors' survey showed high satisfaction with the application process and gave key notes for future improvement, such as including a clinical instructor in the TBL sessions with more clinical application.

The take-home message

TBL is an effective teaching and learning method for physiology, integrating it with clinical disciplines. The learning process in TBL includes three levels: 1) student individual level (pre-class preparation); 2) student group level (in-class tasks); and 3) TBL instructor level (clarification of difficult concepts). The rationale for using TBL is that it is a good interactive alternative to passive lectures, requires no extra facilities or staff, and helps students acquire knowledge and develop interpersonal skills and professionalism. Successful application of TBL requires properly formed and managed groups, student accountability, team assignments that promote learning and team building, and immediate feedback.

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Variability: responders, context and noise?

Bruno Spellanzon & Professor James A. Betts

University of Bath, UK

Bruno has worked in banking and consultancy and, in the middle of a PhD in economics, decided to change careers and start from scratch. Currently doing his MSci in Sport and Exercise Science at the University of Bath, he is planning to do a PhD once again - but this time in human physiology.

James has been with the University of Bath for 18 years, where he is Professor of Metabolic Physiology and Co-Director of the Centre for Nutrition, Exercise & Metabolism. His research integrates molecular and whole-body measurements to understand the regulation of human physiology under various contexts of nutrition, activity and sleep.

Life is messy – with many things happening all at once. The response to any given stimulus often depends on interactions with other parameters, not all of which can be measured with great accuracy nor are necessarily very stable. It is therefore understandable why consistent and predictable responses can be elusive, even when making repeated measurements under seemingly standardised conditions. Indeed, variability in observed data should be expected both due to measurement error surrounding the true value and due to natural oscillations in what value is actually "true" at any given time.

One basic-science approach to this inherent variability in nature is to reduce complex phenomena down to isolated cause–effect relationships, which may then be built back up into complete mechanistic pathways. This systematic reasoning undoubtedly has merits but it can also fail to account for all the various confounding variables that may present necessary, sufficient and/or permissive conditions for a given stimulus to elicit the expected responses.

The above thinking is particularly relevant to the field of human physiology and to the increasingly popular concept of inter-individual variability in responses. Specifically, many physiological effects appear to be present only for certain individuals and/or under certain circumstances but not others. It can then be difficult to understand whether the observed variability is attributable to inter-individual differences (i.e. *organismic* variables), contextual differences (i.e. *environmental* variables) and/or noise in measurement (i.e. responsivity is random). These are clearly important questions since they directly inform whether and how variability data should be used to help personalise interventions and predict outcomes.

Below we highlight just three experimental design issues that are commonplace in human physiology research and can introduce additional variability in response, which researchers may erroneously construe as evidence of inter-individual differences and the existence of "responders" *versus* "non-responders". We will provide specific suggestions in relation to each of these issues, culminating in more general ideas about how to communicate the variability present in data.

Same, same – but different (Standardisation)

One complicating factor when trying to interpret inter-individual differences from the variability evident in human physiological data is that research in this field often adopts a repeated-measures (cross-over) design *and* tends to involve within-subject standardisation of pre-test controls. In practice, this means that each volunteer completes both the intervention *and* control arms under matched conditions for their repeated tests (e.g. at the same time of day, same menstrual cycle phase, same evening

meal the night before, similar activities the day before, etc.). Critically, however, these conditions are not necessarily matched across the different volunteers in the study (i.e. no between-subject standardisation). With this common form of experimental design and controls, no matter how many times the intervention and control arms are replicated, any prediction that a given person is a "responder" or "non-responder" may in fact be dependent on the unique context of their test rather than some personal characteristic specific to that individual (i.e. participants may all respond more similarly if everyone adhered to the same pre-test controls). Whilst using greater between-subject standardisation can therefore help identify inter-individual responsivity, this can also be at the expense of generalisability since group-level effects are all then observed specific to a particular context.

What did you say – what did they hear? (Communication)

Scientific papers reporting human physiological data rightly tend to provide intricate detail regarding objective methods information, such as the exact equipment/apparatus used, calibration procedures and how samples were collected/analysed. However, an absolutely critical but regularly overlooked element of methodological reporting in human physiology is the more subjective account of how researchers communicate study information to volunteers. This mismatch perhaps occurs because the mindset of researchers who tend to think more quantitatively about controlling variables is not usually the same as that of the researcher who tends to think more qualitatively about how human volunteers may interpret or experience a research study.

There is a vast body of evidence from a range of fields showing how individual interpretations of the same message can lead to different outcomes. For example, a person's political affiliation can dictate whether they perceive information in the media to be factually correct (Michael and Breaux, 2021), whereas an individual's cultural and educational background can profoundly influence their understanding of medical advice (Graham and Brookey, 2008). In relation to human physiology research, one example might be an appetite study utilising an *ad libitum* meal test, in which volunteers are presented with an unlimited supply of food and asked *to "eat until you feel full"*. Volunteers are presumably expected to understand that the study is about the physiological mechanisms of appetite regulation (e.g. stomach distension and satiety hormones) and so eating should continue until hunger has been satisfied. However, some may well perceive the message about "fullness" in terms of there being no more space in their stomachs (similar to a "full" battery or fuel tank) or even consuming the amount of food they would consider to be a "full" (i.e. large/main) meal.

Beyond the above laboratory-based example, similar differences in interpretation are also relevant for field-based physiological studies in which there is potential for free-living volunteers to react (or not) to a prescribed intervention. For example, in response to a prescribed dietary intervention, are participants free to spontaneously modify physical activity levels as comes naturally? Far too often this type of research does not provide adequate guidance to volunteers about whether compensatory lifestyle changes in response to the intervention are permitted (or at least any such guidance does not form part of the published report, yet is absolutely central to understanding the research findings).

It only takes a minority of research volunteers to interpret study requirements differently to the intended meaning understood by others for there to be increased variability in response – possibly leading to (mis) classification of some individuals as distinct "responders". Researcher communication and participant interpretation therefore clearly matter and, especially when considering inter-individual variability, studies involving human volunteers should: carefully consider and standardise the precise wording of participant information (perhaps using written or audio-recorded statements); verify each individual's understanding of that information (perhaps asking them to repeat it back in their own words); and thoroughly detail these communications in the published report of the study.

The more things change – the more they stay the same (Familiarisation)

Another specific issue that occurs more in human physiology than some other fields of research is the potential for trial-order effects of one kind or another. For example, clinical trials more frequently employ independent/parallel groups designs (i.e. no repeated testing) and/or involve a more innocuous one-off assessment of a given outcome at follow-up (i.e. no lasting effects between repeated measurements). By contrast, many basic science questions in physiology tend to involve relatively extensive, invasive and/or repetitive assessments, such that systematic changes in outcomes over time can occur due to inadequate recovery from previous tests (e.g. fatigue) and/or some form of familiarisation with those tests (e.g. adaptation or learning).

An informative example might be an investigation into whether antioxidant vitamin supplementation confers protection against exercise-induced muscle damage. As we all know from personal experience,

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unaccustomed physical exercise can result in muscle pain the next day (commonly known as delayed onset muscle soreness). This tenderness results from the initial mechanical strain of muscular activity, combined with a secondary chemical injury due to oxidative stress and subsequent inflammation (Pyne, 1994), thus providing the rationale for examining dietary antioxidants. Let's therefore imagine a study in which habitually inactive individuals ingest a daily vitamin E supplement (or placebo) for one month, before completing intense exercise and then rating their perceived soreness 24 hours later. This will be a fully randomised and counterbalanced experiment using a simple 2-by-2 AB/BA cross-over design – meaning that all volunteers will do the exercise test on two occasions separated by (say) one month: once following vitamin E supplementation and once following placebo supplementation (with half receiving vitamin E first and half receiving placebo first).

The reason for selecting this particular example is that both exercise-induced muscle damage and vitamin supplementation introduce separate issues for a cross-over design that can interact to present major challenges during analysis. Firstly, it is well-established that eliciting exercise-induced muscle damage on a single occasion imparts a marked degree of resistance to the damaging effects of similar exercise in the future - an adaptive response that can last at least 6 weeks (Byrnes *et al.,* 1985). This type of *period effect* therefore results in a consistent change in outcome measures from the first to the second test (irrespective of the sequence of treatments), potentially due to some difference between baseline and follow-up either in the participants, in the conditions of the study, or in the calibration of measurement tools. Whilst not ideal, this effect should influence both sequences AB and BA similarly (provided that the experiment was counterbalanced), so it may be possible to adjust the analysis of a straightforward AB/BA cross-over in order that the effect of treatment can still be estimated (Dwan *et al.,* 2019).

Secondly, it is also well-established that lipid-soluble compounds such as vitamin E exhibit a relatively slow intracellular turnover and can accumulate in various tissues (e.g. adipose, adrenals, liver and muscle; Packer, 1992), meaning that supplementation ahead of the first test may result in an increased antioxidant status that persists through to the second test. This form of *carry-over effect* therefore results in a treatment effect that depends on the sequence of treatments (commonly due to an inadequate "wash-out" interval before repeated tests), which can be further complicated if for example one treatment already works more effectively when applied in either the first or second test (i.e. a treatment*period interaction). Unfortunately, in this instance there is currently no accepted remedy to tease apart the carry-over and interaction effects via *post-hoc* statistical analyses (Senn, 2002), so these effects can confound interpretation both of the primary analysis at a group level and of variability analysis at an individual level (e.g. identifying certain individuals as "responders" when their apparent responsivity depends entirely on the sequence of treatments).

It is therefore advisable to carefully consider the likelihood of carry-over/interaction effects at the experimental design stage. The above example demonstrates that neither randomisation nor counterbalancing does anything to prevent the treatments or measurements involved during an initial test from exerting a lasting or even permanent influence on future tests. Instead, if it cannot be confidently assumed that measurements will be stable across repeated tests, pre-emptive solutions could include: allowing an adequate washout interval between tests; recruiting a population who are already accustomed to the tests (possibly by familiarising them with preliminary tests); or using an independent/parallel groups research design (possibly a *Solomon Four-Group Design* if within-subject contrasts are integral to the research questions).

Show me the data (Visualisation)

As is generally the case for effective results reporting, when considering variability there really is no substitute for full and transparent presentation of individual data. Thoughtful visualisation can convey numerous aspects of the underlying information, complement and inform any more formal statistical analyses, and enable others to further interrogate the source data using whichever analytical approaches that may be preferred in future.

A and B in Fig.1 illustrate the same dataset: Fig.1A reflects the rather uninformative presentation that sadly can be found in many published articles. Not only is this manner of solely presenting a measure of central tendency in each condition an inefficient use of page space (since the same amount of information could be conveyed in text as just two digits) but in physiology research can also reflect a waste of analytical resource (for example, if a researcher was genuinely only interested in the mean blood glucose concentration of a group, then why not just combine the blood of all participants and analyse a single mixed sample?). Of course, in reality, most researchers are interested in variability and at least recognise that individual data are needed for inferential statistical analysis – yet the furthest most papers go in sharing that variability with the reader would be to add error bars to Fig.1A. It is generally a standard deviation used for that error bar, which tells us nothing about the consistency of responses within each individual (only the spread of scores between different individuals) and so the mere inclusion of error bars is not a huge advancement beyond presenting the mean alone (especially when considering the relatively limited sample sizes and often skewed frequency distributions in human physiology research).

On the other hand, one potential advantage of having relatively few individual data points is that this presents an opportunity to fully present all source data in a graphical format. For example, to return to some of the research design issues identified earlier, the

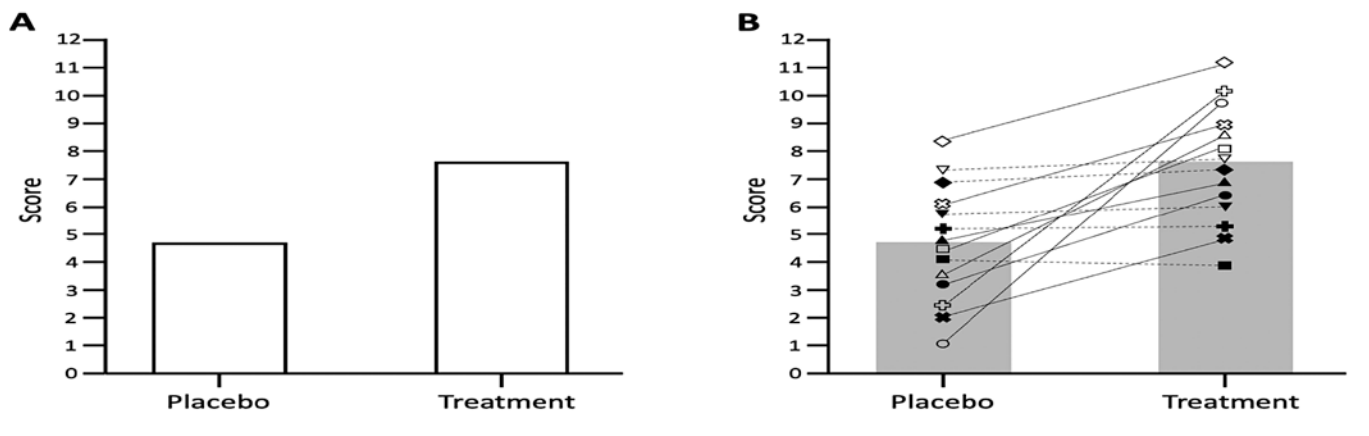

Figure 1. How to present your data? A and B illustrate the same dataset.

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unfilled versus filled symbols on Fig.1B could reflect some element of standardisation in pre-test controls – perhaps depending on which individuals did versus did not exercise in the 24 h before each test, respectively (so in Fig.1B that might indicate that prior exercise sensitises participants to the intervention). Similarly, pairing the individual scores between conditions with lines not only illustrates at a glance the consistency of the treatment effect overall but the dashed versus solid lines can also reflect the counterbalanced order of conditions – perhaps depending on which individuals received the placebo versus treatment in their first test, respectively (so in Fig.1B that might indicate that the treatment was only consistently effective when applied in the first test). Notably, with the sample sizes typically found in human physiology research, it is usually possible to allocate each individual participant a dedicated symbol, which can then be used throughout the results section so readers can cross-reference between outcome measures (i.e. to question whether certain individuals consistently rank high or low in the sample).

Using graphical communication as described above can encourage and enable readers to consider the context in which the primary hypothesis was tested but may also generate additional hypotheses that had not previously been considered. In fact, it is difficult to think of any good reason why a full report of individual data would not be recommended – perhaps only in cases where the sheer quantity of data would render the graph indecipherable or, arguably, where the reliability of a measurement tool is only really adequate at a group level (so it might be considered prudent *not* to encourage a focus on individual responses). Nonetheless, the fact remains that graphical presentation of data is an underappreciated art. Researchers generally accept (albeit often grudgingly) the prospect of spending days or weeks to select and conduct the most appropriate statistical analyses, yet decisions about data visualisation are often made in seconds and barely receive a second thought. It has been argued that *"a picture is worth a thousand p-values"* (Loftus, 1993) and we contend that appropriate presentation of individual data surely accounts for a good proportion of that number.

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Meeting Report

Europhysiology 2022 Teaching Symposium Report: Research-Based Learning Design and Active Learning Spaces in Physiology Teaching

18 September 2022, Copenhagen, Denmark

Dr Clare Ray

University of Birmingham, UK

Dr Nicole Schmitt

University of Copenhagen, Denmark

Professor Chaya Gopalan

Southern Illinois University Edwardsville, US

Dr Charlotte Haigh

University of Leeds, UK

2022 Europhysiology teaching symposium - chairpersons

The Teaching Symposium at Europhysiology 2022, Research-Based Learning Design and Active Learning Spaces in Physiology Teaching, took place on Sunday 18 September 2022 and despite being scheduled the morning after the conference dinner was very well attended by an engaged and interactive audience. The aim of the symposium, co-chaired by Dr Nicole Schmitt of the University of Copenhagen, Denmark, and Dr Clare Ray of the University of Birmingham, UK, was to showcase the various elements of active learning that can be introduced into physiology teaching in a variety of achievable ways.

Adopting an active teaching approach

Clare introduced the symposium and discussed some of the evidence that supports the use of active teaching in physiology. She shared some of her own examples and experiences of using active approaches to learning and adapting assessments to evaluate understanding and deep learning. These included the use of the flipped classroom approach for the delivery of respiratory physiology to large groups of medical students (~400 students), online platforms including Lt (ADInstruments) to support engagement prior to and during laboratory practicals, and digital tools like Padlet to support discussion activities in small group sessions. She highlighted the importance of explaining to students the rationale for adopting an active approach, including sharing with them the evidence to support its use.

Flipped teaching

Chaya Gopalan (Southern Illinois University Edwardsville, US) started her presentation by defining flipped teaching. Next, she introduced her study design involving faculty from two different institutions attending faculty development workshops to be able to implement flipped instruction in their classrooms. Cohort 1 was testing flipped teaching implementation for a year before cohort 2 started, and therefore, cohort 1 mentored cohort 2. Chaya discussed how faculty perceptions, attitudes, and intentions toward flipped teaching implementation

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became more positive as they developed expertise. She also shared how participants continued to use flipped teaching in the remote setting during COVID-19 and reported that flipped teaching knowledge and resources helped them transition more quickly than those who did not. She talked about how students with greater college experience found flipped teaching more helpful than first-year students. She concluded by saying how flipped teaching could be used in multiple settings to engage students.

Active learning methodologies

Charlotte Haigh (University of Leeds, UK) discussed with us a module that encompasses research-based content, that is framed around what competencies students wish to gain experience in, and delivered using active learning methodologies, assessed in an inclusive manner. Researchers pitch their research projects to students who are Year 2 undergraduates from a variety of disciplinary backgrounds. The students then choose a research project and design a public engagement event to help communicate the research to a specific audience of their choice. Each session supports this outcome, by utilising guest speakers and interactive discussions that will help the students plan such an activity. The students have a choice of assessment outputs, such as writing a grant proposal, recording a short presentation or producing a digital portfolio to pitch the idea to a grant body for funding. This is all supported by formative feedback on initial ideas before the output for assessment.

A student-centred learning approach

Nicole shared some of the theoretical basis for her teaching practice in various study programmes (e.g. medicine, odontology, medicine & technology) at the University of Copenhagen. She introduced the student-centred learning approach by Knud Illeris, where the individual's learning takes place in the interplay between cognitive, social and psychodynamic dimensions (Illeris, 2018). She presented the concept of the "implied student" (Ulriksen, 2009) and stressed the importance of safe learning environments and alignment of expectations to increase the students' activity, reflection and learning. Her examples for activating teaching formats revolved around synchronous, hybrid, and interactive lectures with up to 400 students and aimed to demystify the use of activating formats in the lecture setting. The examples included direct feedback using student-response systems with quizzes at different taxonomic levels and examples for successful group work in the lecture setting.

The final 30 minutes of the symposium allowed those attending to discuss the question *How can we support one another to develop active learning and teaching in physiology?* There was lively discussion in the room and on the dedicated Padlet discussion board, which continued into the final question and answer moderated podium discussion where many ideas were shared. There was a lot of enthusiasm for further collaboration between individuals and the various physiological societies represented. We hope to see the results that arise from these conversations presented at future meetings.

For those unable to attend Europhysiology 2022, recordings of the symposium talks are available on the websites of the Scandinavian Physiological Society and The Physiological Society's Training Hub.

2022 Europhysiology teaching symposium - camera set-up

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"The aim of the symposium was to showcase the various elements of active learning that can be introduced into physiology teaching in a variety of achievable ways."

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Meeting Report

Innovation and Updates in Teaching and Student Education across Physiology and STEM in the UK

12-13 April, University of Leeds, UK

Professional Development

Dr Alex Holmes

University of Leeds, UK

I'm very new to the role of Teaching Fellow in Physiology, having only started the post in December 2022. So, as you can imagine, a two-day conference focusing on physiology pedagogy was an exciting but also daunting prospect! Despite that, the moment I turned up on the first day (or perhaps the second moment, a coffee was needed first), I was surrounded by friendly faces. Previously, I've only ever gone to more research-focused conferences, where teaching has felt like an afterthought, or wider education conferences, where it can be harder to find the physiological niche to discuss topics that are more centred to my role and interests. Whereas here, nearly every presentation, conversation or question felt tailored to me and the areas I wanted to explore as an educator.

The main thing I wanted to know, as someone who is incredibly early career and just starting to make my way in bioscience education, was how career progression worked and how I could set myself up to be successful from the earliest opportunity. I found that, as well as titbits I picked up over coffee, the conference had entirely foreseen and provided for my need through the Training Hub sessions.

The first session was a four-member panel from newly appointed to a permanent position, through to promoted to professorship based on teaching and scholarship. This was a brilliant opportunity to hear from people about their paths to where they are now and collect their advice. I must admit I have several scrawled pages of notes thanks to this session. I loved the mix of celebration of achievement and joy in accomplishments, tempered with frank and honest advice. Although I'm likely a little while off some of the career steps being discussed (although I wouldn't say no to a professorial position if anyone's offering), the advice from all levels felt very applicable and has given me a much clearer idea of how to identify the areas and activities I can be involved in now that will help my progression in the future.

The second two-day session gave me another look at career progression, through the lens of demonstrating the impact of scholarship work. Here I gained some great ideas around how to group and structure examples of impact, and how to strategically do scholarship work while maintaining other responsibilities, by "make[ing] your academic role the basis of your scholarship" (Sarah Hall). Although I'm already used to quantitative measures of impact, getting more examples and insight into qualitative evidence was very valuable. These two sessions have left me with a rather sizeable wish-list of things to get involved in and do, but I've already signed up for more Training Hub sessions to get even more of this kind of content.

Overall, these were incredibly valuable days spent with brilliant people. I'm grateful that the Biological Sciences Teaching Innovation Hub supported me to attend and to Charlotte Haigh, Chris Randall, Ruth Norman and The Physiological Society for organising.

Assessment Matters

Dr Sarah Calaghan

University of Leeds, UK

I attended The Physiological Society meeting in Leeds with my Assessment Lead and Academic Integrity Officer hat firmly in place. However, I came away thoroughly inspired by so many other aspects of teaching and student education that my hat had slipped somewhat by the end of the second day! The breadth of experience and approaches from the many presenters was impressive, and the

https://doi.org/10.36866/pn.130.40

balance of longer talks and five-minute flash talks ensured that the audience was always engaged.

Here I will pull out some valuable insights into assessment matters from the mix.

There are many issues affecting assessment at present. One of these is ensuring that we meet the needs of a diverse student population. This issue was addressed by Nicholas Freestone from Kingston University, where students from ethnic minorities and with high measures of deprivation form the majority of the cohort. Detailed breakdown of coursework and exam grades against ethnicity reveals anomalies in performance, raising the question: How can we cater for different groups when we assess? Dr Freestone's view – that we probably cannot entirely manage this– is pragmatic, but was balanced by some interesting ideas of engaging students with work from scientists of their own ethnicity in preparing literature reviews or Capstone reports.

One particularly pressing issue regarding assessment is the advent of AI tools such as ChatGPT, which has stirred panic throughout the community. The initial knee-jerk reaction (go back to in-person exams) is being replaced by a more realistic view of the possible advantages of this technology. Dawn Davies (Bristol) encouraged us to exploit AI tools. She proposed using ChatGPT-generated text as a basis for assessment of students' ability to critically evaluate (sense, accuracy, and support from the literature).

An assessment such as this teaches students skills, but it also confers the notable advantage of highlighting the limitations of AI tools. Another positive outcome of the advent of AI tools is that it provides a stimulus for designing more authentic assessment, as highlighted by Harley Stevenson-Cocks (Newcastle).

The drive for more authentic assessment has been around for a while, even before the emergence of sophisticated AI tools. Clare Tweedy (Leeds) described a problem-based learning approach used in a large cohort (220 students) Neurobiology module. A problem (clinical case study) was used to drive, rather than test, learning in small, facilitated study groups timetabled over a four-week period. This approach was highly rated by the class. Dave Lewis (Leeds) showcased authentic assessment in the breadth of student Capstone projects offered, giving students responsibility for choosing a project that feeds directly into their planned career choice (whilst the shorter focused output also reduces the assessment load for staff – what is not to like?).

"Synoptic assessment" is another aspiration for many institutions- to encourage students to integrate information taught on different modules and to promote deep learning, whilst reducing over-assessment. Derek Scott (Aberdeen) gave a pragmatic introduction to inclusion of physiology "Core Concepts" in curriculum design, including assessment. He highlighted a paper published this year by Crowther and Knight (doi: 10.1152/advan.00024.2022), which proposes the use of conceptual framework-linked test question templates that essentially could be used to synoptically assess students' understanding of a concept that is relevant to multiple areas of physiology (i.e. cross-modular).

It is difficult to talk about assessment without mentioning feedback, and there was plenty of stimulating discussion around this. Damian Parry (Newcastle) addressed a fundamental issue of the discrepancy between student and staff perception of feedback. He gave some practical guidance regarding resetting new students' expectation of feedback (with regard to how this differs from feedback at school), including simple changes to nomenclature, the need to be explicit about what feedback is. Dr Parry also put forward the view that feedback (and feedforward) can be used to build an academic community and better relationships with students, particularly if this is verbal and/or students know who marked their work.

This idea of using feedback to build a sense of community was exemplified by a flash talk given by Ai Na Ng (Bristol) who described a feedback café experience. Here students were given the opportunity to meet with the teaching team in a social space with a view to discussing a piece of marked work, which helped students engage and understand feedback.

So lots of food for thought and practical guidance that we can easily apply; two days very well spent!

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Meeting Preview

Regenerating the Cardiovascular System: Mending Broken Hearts and Beyond

13-14 September 2023, University of Oxford, UK

Dr Mathilda Mommersteeg
University of Oxford, UK

Dr Caroline Pellet-Many
Royal Veterinary College, London, UK

Professor Paul Riley
University of Oxford, UK

We are looking forward to welcoming members and non-members to our Physiological Society meeting "Regenerating the Cardiovascular System: Mending Broken Hearts and Beyond" taking place in Worcester College at the University of Oxford, UK on 13-14 September 2023.

Cardiovascular diseases are still the leading cause of death in the Western world and heart failure resulting from myocardial infarction is a devastating illness and global pandemic, costing billions to society. In recent years, the study of model organisms with high cardiac regenerative capacity, such as the zebrafish and neonatal mouse, has provided critical insights into the molecular mechanisms and cellular processes orchestrating cardiovascular regeneration. In particular, the de-differentiation and reprogramming of adult cells and the re-expression of an embryonic genetic profile has been elucidated, highlighting the importance of a clear understanding of the control and regulation of cardiovascular development.

This two-day meeting, supported by the Oxbridge British Heart Foundation Centre of Regenerative Medicine, will showcase the recent advances in the field of cardiovascular repair and regeneration. We have lined up a fantastic list of world-leading experts but would also like to hear about your research. You are warmly invited to submit your abstract for oral and/or poster presentations to disseminate your favourite topic in the field of cardiac development, repair, and regeneration.

The conference will be focusing on different cellular responses and control of the regeneration process, including cardiomyocyte proliferation, the role of the immune system, revascularisation of the injured heart, metabolism and cardioprotection as well as novel animal models of heart regeneration.

The conference will take place at the University of Oxford, which is a well-known hub for its groundbreaking research in the field. It will be hosted at the beautiful Worcester College in the centre of Oxford.

In addition to our exciting scientific programme, participants will have the opportunity to network and share knowledge and new ideas at the poster session and at the conference dinner, which will take place at St. Cross College, a short walking distance through historic Oxford.

We hope that you can join us for a friendly and inspiring meeting in September!

Key dates

Registration opens:
6 April 2023

Abstract submission period:
1-30 June 2023

Conference Attendance award deadline:
31 July 2023

Early bird registration deadline:
26 July 2023

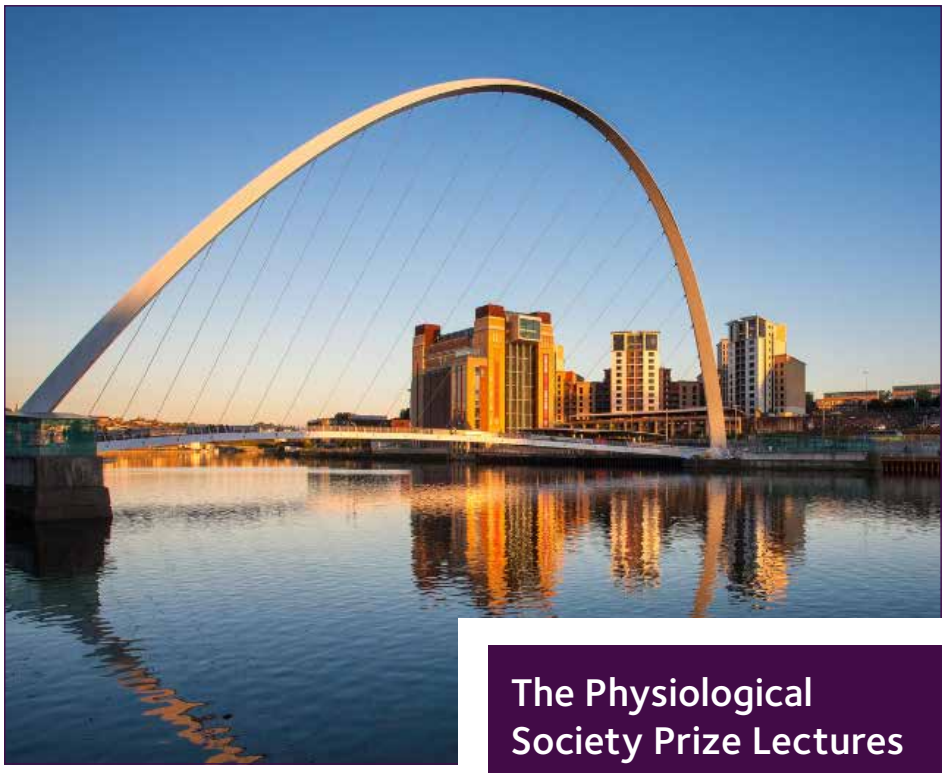
Online registration deadline:
30 August 2023

https://doi.org/10.36866/pn.130.42

Meeting Preview

Physiology in Focus 2024

2-4 July 2024, Northumbria University, Newcastle upon Tyne, UK



The Physiological Society and The Scandinavian Physiological Society are delighted to be hosting a joint conference in July 2024, Physiology in Focus 2024.

The scientific programme promises a selection of the best and most exciting in current physiological research, including inspirational plenary and keynote lectures. There will be three days of the latest exciting physiology including Special Interest Group meetings, symposia, oral communications, and posters.

"The Scandinavian Physiological Society is very excited about collaborating with The Physiological Society on Physiology in Focus 2024. It makes a lot of sense for next-door neighbours to join annual meetings, particularly because our collaboration has worked really well in the past. It has actually been great fun and brought a lot of creativity into the game of arranging scientific meetings.

With both societies emphasising the bottom-up process, we will be anxiously waiting for your great input to speakers and symposia. It is our task to bring you the benefits of a broad meeting with the networking and community feel of a focus meeting. I really look forward to the work."

Professor Helle Prætorius Øhrwald (Aarhus University, Denmark), President of the Scandinavian Physiological Society

"I'm delighted that we are to have a joint meeting with the Scandinavian Physiological Society. I have benefited greatly from collaborations with Scandinavian labs, and scientists from all the Scandinavian countries have made crucial contributions to our understanding of diverse physiological mechanisms.

These include (with Nobel Prize dates in brackets) the Faroese-Icelander Niels Finsen's work on phototherapy for lupus (1903), the Dane August Krogh's proposal of capillary-level regulation of blood flow (1920), the Finn Ragnar Granit's work on the eye (1967), the Swede Torsten Wiesel's contribution to understanding how the brain processes visual information (1981), and the Norwegians May-Britt and Edvard Moser's work on spatial representation within the brain (2014).

I'm sure this outstanding tradition will be much in evidence at our joint meeting, and I look forward to the friendly and exciting exchange of information and ideas that will occur there."

Professor David Attwell (University College London, UK), President of The Physiological Society.

The call for symposia for the conference is open now until 30 June 2023.

The Physiological Society Prize Lectures

The Annual Review Prize Lecture
Professor Jens Juul Holst, University of Copenhagen, Denmark

The Bayliss-Starling Prize Lecture
Professor Colin Nichols, Washington University St. Louis, U.S.

The Joan Mott Prize Lecture
Professor Janna Morrison, University of South Australia, Australia

The Michael de Burgh Prize Lecture
Professor Alexander Gourine, University College London, UK

The Otto Hutter Teaching Prize Lecture
Professor Frankie MacMillan, University of Bristol, UK

The Paton Prize Lecture
Dr Sean Roe, Queen's University Belfast, UK

Key dates

Society member registration opens:
3 January 2024

Abstract submission:
1-31 March 2024

Conference Attendance award deadline:
31 May 2024

Society member early bird registration closes:
31 May 2024

https://doi.org/10.36866/pn.130.43

Your exclusive access to on-demand resources and webinars

In April we launched the Training Hub, which provides the support essential to your career. As a member benefit, the Training Hub is your home for resources and workshops to unlock your potential and advance your career.

Changing how members access career support

In recent years The Society has invested more resources into offering professional development support designed to address career challenges or to upskill members. The COVID-19 pandemic accelerated the need for online content covering a wide range of topics. This taught us a lot about the broad range of skills a physiologist requires and The Society's role in offering support beyond what's available at a member's institution.

How the Training Hub can support you

The Training Hub can help you to

- Plan your career next steps
- Improve your teaching
- Develop your research skills

The Training Hub homepage will keep you updated with what's new or topical. The resource library hosts resources for members from on-demand webinars, cheat sheets and templates on topics such as publishing, funding and career planning. The development of content and opportunities showcased on the Training Hub is tailored by members for members to support best the communities we serve.

New video series for lecturers

Are you looking for tips to apply to your teaching methods? Professor Matthew Mason from the University of Cambridge tells us more about the new go-to video resources to support new lecturers teaching basic systems physiology.

Professor Matthew Mason

University of Cambridge

It is clear to see that there is an increasing disconnect between what we research, and what we need to teach to undergraduate students. Students, especially in medicine and allied disciplines, need a strong grounding in basic systems physiology, but this is less and less likely to have been a central focus in the PhD and postdoctoral training of newly appointed lecturers. Physiology is a conceptually complicated science and being asked to design and present a course on, say, electrochemical gradients can be daunting for a young academic with little or no background in the field, especially if their university lacks more senior lecturers who can act as mentors.

For this reason, I have been working with The Physiological Society to create video-based resources aimed at newly appointed lecturers, to help get them started. These are not about how to present a lecture in general terms as there are plenty of excellent pedagogical resources available to help with that sort of thing. They are instead about what aspects of physiology to focus on.

Each series will focus on a key area and be presented by an experienced lecturer outlining, in less than half an hour, what some of the core concepts would be. These will tackle where students often get confused and offer analogies and demonstrations that might be helpful in getting the more complicated ideas across.

Our first video series is in three parts and covers cardiovascular physiology. We will be following this with similar videos on other physiological topics selected by a focus group of young academics. These will be presented by other experienced lecturers from around the country.

Watch the video series at physoc.org/resource-library/teaching-the-core-concepts-of-cardiovascular-physiology-part-1/

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To what extent do you think COVID-19 has impacted physiology teaching?

Our focus group of early career lecturers share their thoughts on their career journeys in academia. They cover transitioning from teaching assistant to lecturer, the changing landscape of physiology teaching in the aftermath of the pandemic, challenges lecturers face and adopting new approaches and tools. We share snippets of their blogs below. Visit our blog for their full stories.

Reflecting on flipped classroom teaching

Dr Matthew Jacques
University of Nottingham, UK

COVID-19 resulted in many changes in how we teach, the most prominent being the shift to online teaching. We learnt a lot in the first year of the pandemic as we tried out different approaches, including more effective use of virtual learning platforms and integration of interactive tools into teaching. One of the most prominent and successful methods was the implementation of a flipped classroom approach.

Continue reading at physoc.org/blog/reflecting-on-flipped-classroom-teaching/

The changing landscape of physiology teaching

Dr Chinedu Agwu
Brunel Medical School, Brunel University London, UK

Historically physiology teaching has been approached using lectures, tutorials and complementary lab practicals to support learning. Rather than using traditional didactic lectures the main teaching pedagogy adopted in our programme is team-based learning (TBL), in which students learn in teams and scientists, alongside clinicians, teach in teams combining their diverse expertise.

Continue reading at physoc.org/blog/the-changing-landscape-of-physiology-teaching/

The academic shuffle

Dr Lewis Mattin
University of Westminster, UK

Academia is the finest job in the world. Or so they tell us. In all seriousness, what other job gives you the possibility to travel the world to exhibit and expose novel scientific findings and even undertake or observe a development in an area you are extremely passionate about? I believe all lecturers have an inquisitive mind about understanding the unknown.

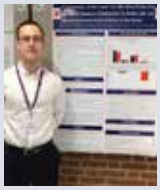
Continue reading at physoc.org/blog/the-academic-shuffle/

An Early Career Lecturer's insight into teaching

Dr Colleen Deane
University of Southampton, UK

As an early career lecturer in muscle cell biology, the idea of teaching physiology to medical students was daunting initially. In September 2022 I presented my first set of lectures (as a Lecturer) on the importance of protein and amino acids for muscle and bone. These lectures were very well attended, with more than 150 students out of approximately 200 in the lecture theatres at any one time.

Continue reading at physoc.org/blog/an-early-career-lecturers-insight-into-teaching-physiology/



Beginning a career in academia

Paul Lester
University of East London, UK

I worked as a lecturer at the start of the pandemic, then went into public health and returned to academia as the pandemic came to an end. I think the pandemic has had a substantial impact on resource-intensive disciplines, such as physiology, as students have not been able to access the facilities required to develop the practical and interpersonal skills to work as an exercise physiologist.

Continue reading at physoc.org/blog/beginning-a-career-in-academia-what-support-and-changes-could-help-physiologists/

The impact of COVID-19 on physiology teaching

Dr Harley Stevenson-Cocks
Newcastle University, UK

Given that physiology is the science of life, and life was put on hold over the course of the pandemic, COVID-19 obviously had a major impact on physiology teaching. Though we were fortunate to deliver some practical teaching during the pandemic, physiology practicals were not possible due to the very nature of involving data collection from, and close contact between, students.

Continue reading at physoc.org/blog/the-impact-of-covid-19-on-physiology-teaching-and-current-challenges/

Access the Training Hub today to book upcoming live workshops and webinars, to learn new skills and build your networks. Members get free access to webinars and discounted rates for workshops. This includes techniques workshops and focused webinars to help overcome career challenges, all with like-minded members. ***physoc.org/training-hub/***

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Space physiology: Broadening the horizons of health research

Sara Valkila

University of Aberdeen, UK

Are you a life science student who is interested in space? If not, maybe you should be. Before I attended the European Space Agency's (ESA) training programme, I knew very little about space physiology. I am a 3rd year BSc student at the University of Aberdeen, UK, studying biomedical science and specialising in anatomy in my honour's years. For the past two and half years studying countless modules related to physiology, it had never occurred to me how much Earth's gravity has affected the evolution of our physiology. I thought that space research was about unravelling the story of our universe and discovering celestial bodies but it turns out it can also help us know more about health and disease as well.

In November 2022, I travelled to the ESA Academy training facility in Belgium, for the Human Space Physiology Training Course 2022. I had first heard about this course from my professor the previous year. Around 30 of us medical, biomedical, and other life science students from all around Europe gathered to learn about the physiological challenges that astronauts operating on the International Space Station (ISS) or on the lunar surface have to face. The training course is an exclusive opportunity to learn from cutting-edge researchers in the field of space medicine, physiology, and biomedical engineering to further our understanding of the physiological effects that the space environment has on the human body.

Why study space physiology?

Space has fascinated me since I was a child and I have always cheered for space programmes. However, with my interests lying in medical science, I felt I could not contribute to the field and so never really considered it as a possible career path. When I heard about the ESA training programme, I immediately recognised the doors it could open in the future and how wrong I had been.

Space physiology is a beautifully niche area of research and has numerous applications outside space exploration. It provides an opportunity to literally think beyond the confines of the Earth to consider how living systems could exist outside of it. Physiology tells the story of the mechanisms underlying all life. Imagining how humans could sustain life on, for example Mars, forces you to harness all that knowledge. An environment that involves high doses of radiation, extreme temperature changes and microgravity provide a unique set of challenges that you do not encounter in your day-to-day physiology problems. On this course we were taught how these challenges have been reconciled so far and which research methods can benefit us in the future in supporting the health and performance of a human in space. Personally, I could not think of a more inspiring task.

An intensive course covering all major areas of space physiology

During the course, experts working on research ranging from earth-based analogues conducted at the Concordia research facility on the Antarctic Plateau to physiologists and medical experts training new astronauts were giving lectures and sharing their findings. Every day involved two to five lectures, which would each be followed by a Q&A session, as well as allocated time to work on group projects. We also had the privilege of an exclusive visit to the European Space Centre, the European Space Security and Education Centre (ESA ESEC). Despite the intensive schedule there was plenty of time for networking and socialising with not only the students but the visiting lecturers and researchers.

One does not have to be a space enthusiast to get on board as the programme starts with a crash course into the history of human spaceflight and the role of ESA in the global space exploration community. The 20 lectures on the course gave a comprehensive view of human spaceflight and how the physiological effects are studied. Examples of topics covered:

- space environment and its challenges
- work of the Space Medicine Team
- neurosensory and neuromuscular function in space
- effects on cardiovascular and skeletal physiology
- the technological innovations that aim to counter deconditioning in space
- methods of human space research

Applying space mission research to the clinical health setting

I personally most enjoyed the session covering the impact of space on the brain and the neurosensory system as well as the musculoskeletal system. Some of the negative changes, such as muscular atrophy, loss of bone density, and neuroinflammatory stress that astronauts experience during and after space flight are commonly associated with ageing. I believe that these ground-based analogues, originally designed for human spaceflight research, could potentially be used to identify biomarkers related to neurodegenerative disease.

I was particularly fascinated by how changes in neuroanatomy and neurophysiology lead to adaptations and that there are many examples of neuroplasticity. That being said I would highly recommend this course to anyone interested in studying neurodegeneration and plasticity. The course also offers a lot to exercise physiologists and sport scientists interested in performance and reconditioning as this is potentially the most significant aspect of maintaining astronauts' overall health and performance during their mission.

Each session ended with a Q&A with the person giving the talk. These discussions were really the essence of this course as they allowed the students to contribute their own expertise or knowledge and share it with everyone. Being from a science background myself, it was particularly interesting to listen to medical students cleverly apply their knowledge from the clinical setting to the healthcare of astronauts. For me, this is what made the course so special.

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On the group projects we focused on the challenges of human spaceflight in the future and how to produce a roadmap to safer space exploration. This was a fun project as we got to apply the physiological knowledge of the researchers as well as study the literature. I personally was not familiar with the topic nor the relevant literature, which was challenging, but we had access to experts from whom we could ask questions and receive help.

A future at ESA or the Space Medicine Team?

The variety of speakers on the course demonstrated that the paths to ESA or space physiology research in general are incredibly varied and that people come from many backgrounds to participate in this multicultural and interdisciplinary community that is surrounding space medicine. One of the sessions inspired me to design cell culture experiments that apply my lab internship experience to the study of inflammation and neurodegeneration in space.

It definitely had an impact on my way of thinking about interdisciplinary research. That one session inspired an idea for my own PhD project, where I would like to design experiments that could benefit the space physiology community. I had not considered a career in industry, but this programme made me think of space physiology as an intermediate option somewhere between academia and industry. This training programme is an entirely one-of-a-kind opportunity for students to develop their graduate attributes in physiology and the organisers are openly encouraging participants to consider ESA as a career option.

How to take part in the programme

Biomedical and medical students both at the BSc and MSc level can apply each year on ESA's website. To apply, students must submit a CV, an abstract and a motivational letter as well as academic transcripts and reference letters. Background knowledge in physiology could help you gain more out of the course and familiarising yourself with the relevant literature will help you draft a strong application. At the end of the course students are awarded a course certificate, university credits, and a grade for their group project. Thus, it is also a way to add something unique to one's academic records. Some of the MSc-level students on the course were already running their own projects with ESA or were planning to do their master's thesis on space physiology. It is a great place to get inspiration and make connections that might open doors in the future.

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Physiology in Focus 2024

A joint conference of The Physiological Society and The Scandinavian Physiological Society

Northumbria University
Newcastle upon Tyne, UK

2 — 4 July 2024

Join us for three days of **first-class science** and **unmissable networking opportunities** in historic & vibrant Newcastle upon Tyne

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