PRACTICE-BASED ACTIVITIES: LABS, STUDIOS AND FIELDWORK

This guide provides advice and links to resources to help staff develop online and blended alternatives to labs, studios and fieldwork.

At the time of writing, Heriot Watt's campuses – as for most universities – are completely closed: buildings are shuttered, staff are working from home, and the vast majority of students are away from campus. Teaching is taking place remotely, and while many activities have already been moved online, there are some learning experiences for which the electronic pivot is much less straightforward. For many disciplines, practical (hands-on and location-based) skills and knowledge are a key focus of students' activity. Science and engineering students learn lab techniques and the ability to design and execute experiments; students in subjects like geoscience and geography spend time in the field; design students create physical artefacts in shared studio spaces.

During the current lockdown, there is a need for staff in those disciplines to develop online alternatives to physical studios, fieldwork and labs. Looking ahead, we are likely to enter a period when staff and students can attend the campuses but with physical restrictions. The Responsive Blended Learning approach will be required, to combine active and supported online learning with face-to-face learning. With the Virtual Learning Environment (VLE, which at Heriot watt is also called 'Vision') as the central hub, students will begin their academic year on time, and progress through their programme as a part of a cohort: collaborating, building friendships and forging a community. Creative solutions will be required for practice-based learning, to enable students to proceed with their studies whatever restrictions are in place.

Online and blended alternatives to physical learning experiences will be highly discipline-specific, and discipline communities – inside and outside the University – are currently working hard to develop creative solutions.

This guide is designed to give you a starting-point, by providing some general questions to think about, and a few links to useful discipline-specific resources.

GENERAL CONSIDERATIONS

1. What are the learning outcomes?

As always, the key consideration when designing learning activities is the learning outcomes: the skills and understanding that students are expected to gain. Rather than trying to replicate face-to-face activities online, the key thing will be finding other ways of addressing the learning outcomes. You will need to consider whether the original course learning outcomes can be met by other means, or whether they need to be changed. Where learning outcomes relate to, for example, the analysis of data, there should be other ways of providing relevant experiences. Where learning outcomes relate to, for example, physically manipulating a particular piece of lab or studio equipment, it may prove impossible to address them during the pandemic lockdown.

As well as the explicit learning outcomes included on the course paperwork, there may be things that you expect the students to learn that are too general, subjective or imprecise to be formalised as learning outcomes. For example, you may see labs as ways for students to understand the role of chance in scientific endeavours, or you may see studios as ways that students develop a sense of belonging. When thinking about online/blended alternatives, it will be worth keeping these additional outcomes in mind.

2. How should resources be prioritised?

Whether learning opportunities have to be provided online, or in physically distanced campus facilities, there are likely to be reduced resources. Lab and studio capacity may be severely reduced; access to online resources may cost money; staff capacity to create videos and other learning materials will be limited. Schools and individual members of staff will therefore need to think carefully (and globally) about how to allocate the limited resources.

As discussed above, the first step is likely to be a consideration of which learning outcomes can be addressed in other ways. And this is where programme learning outcomes will be key; while students in earlier years may be able to delay their fieldwork, for example, final-year students may need to be prioritised in order to ensure they meet the programme learning outcomes before graduating.

Students' levels of knowledge and experience may impact on the effectiveness of alternative learning activities. For example, a virtual field trip may work well for students with some familiarity with fieldwork, but not for first-year students who lack any experience in the field. On the other hand, first-year students may benefit more than other students from non-practical activities hat prepare them for labs (around, for example, experiment design).

3. **What scenarios should we be preparing for?**

Societies around the world are moving from simple and comprehensive lockdowns, to more nuanced situations where some restrictions are lifted while others are kept in place. The implications for university campuses are yet to be seen, and there will be a fair degree of uncertainty as the risk posed by COVID-19 changes (both receding and potentially increasing if there are waves of infection). Colleagues will therefore need to plan for a number of different scenarios:

- **No access to campus learning spaces (labs, studios, etc) or fieldwork.** Learning activities will need to be provided entirely online (or postponed)
- **Staff-only access to learning spaces (labs, studios, etc).** This will allow a number of learning opportunities, with staff able to go into buildings in order to set up and demonstrate techniques, experiments etc., either broadcast live or recorded.
- **Physically-distanced campus attendance or fieldwork.** Strict requirements around physical distancing will affect the number of people a space can accommodate, as well as how people can be arranged, and how long they can be in that space. Collaboration may be much more challenging if students need to be spaced out, and activities may need to be adjusted if students can only be in the space for a limited time. It may also require facilities to be open for more hours in the day, and more days in the week, which will have implications for staff workload. Some use of online learning will be required to ensure that all students can engage with the opportunities. For example, one group of students might undertake an experiment on campus, broadcast live so that other students can comment, advise and take notes.
- **Differential attendance by campus and home country of students.** Campuses and students will be affected differently by lockdown measures. Scotland, Dubai and Malaysia have had different rules throughout the crisis and that is likely to continue. Some countries will have limits on people entering or leaving, and some students will not feel comfortable attending campus even if it is permitted. Some students may need to remain at home for health, family or other reasons. Even when lockdown is relaxed across each of our locations, cohorts are likely to contain a blend of students who are on campus and those who are online.

Given the complexity of the situation, the only practical solution is the Responsive Blended Learning approach: combining active, supported online learning with face-to-face learning opportunities as appropriate, in a way which can respond flexibly to the changing external context. This will enable students to proceed with their studies alongside their peers, whatever COVID-related restrictions are lifted or imposed in specific contexts, and whatever their individual situation.

4. **How can students get the right kinds of feedback?**

One of the key features of labs and studios is the ability for students to get large amounts of quick feedback on work that they are currently engaged in. Tutors can provide instant feedback on a design student's application of a particular technique, and lab demonstrators can quickly comment on a student's experimental set-up. Where students are working remotely, those feedback opportunities will not exist in the same way, and staff will need to think carefully about how to provide sufficient feedback online.

There are a range of tools within the VLE that make it easy for you to create formative assessment opportunities. Quizzes can be an effective way of letting students try out their knowledge of a particular lab technique, for example, and they can even be created with standardised feedback (pre-set by staff). Live webinars are a straightforward way of providing feedback to students in real time, and can be used in creative ways; for example, students could guide a lab demonstrator through an experiment, and receive feedback on their instructions. Collaborate (the webinar tool available in the VLE) offers the ability to create virtual break-out rooms where students can present material and get feedback from each other.

In general, peer feedback is an important part of studio and lab work. In design work, social media platforms (either standard tools like Instagram or more tailored software) can be used to create virtual substitutes for physical studio feedback. A discussion board, or an online chat alongside a live video broadcast, could be effective ways of supporting student discussion.

5. **What external constraints need to be considered?**

A primary feature of the COVID-19 crisis has been the limitations imposed on people's behaviour and that is also true of our ability to provide learning and teaching activities. At the macro level, the rules about what kind of physical activity will be allowed on campus will be largely determined by national governments. When developing ways of providing laboratory and fieldwork learning opportunities, it will also be very important to keep in mind the requirements of professional bodies; to keep up to date with their recommendations, and to contact them about any areas of uncertainty. For design students, their artefacts can form an important part of how they engage with potential employers, and any online studio-based activities may need to serve the same function. In cases like that, the challenges do not fall on students equally, and opportunities for final-year students may need to be designed with particular care.

6. **Are there benefits to developing online opportunities?**

The development of alternative ways of providing laboratory, studio and fieldwork opportunities does open up a range of potential benefits. There have been proponents of computer-based lab simulations for many years, and virtual fieldtrips have gained recent prominence as a way of limiting our impact on the climate, and increasing accessibility to students. The remote use of technical equipment could prepare engineering students for the real-world use of remote monitoring and control tools, while design students' could benefit from using the kind of virtual studio applications that are used in industry. In the search for new ways of doing things, it will certainly be worth giving consideration to how they can continue to be used and developed once something closer to normality returns. For example, recordings of experiments may make good preparatory work for students before they enter labs, and virtual fieldtrips could provide students with experience of a wider range of contexts.

However, in using these kinds of experiences in the current situation as replacements rather than supplements, there will unavoidably be a cost. There will be learning outcomes – intrinsically tied to physical activity or geographical location – that simply cannot be addressed during certain lockdown restrictions. While making the most of the benefits that can be gained, it is important to be honest about what will be lost.

KEY TAKEAWAYS

- **It will be particularly challenging to provide practical learning experiences** such as labs, studio work and field trips in an online environment. Simple replacements may not be possible, and creative solutions will be necessary.
- **The primary focus will be the learning outcomes:** can they be met, or do they need to change? Can activities be moved so they take place later in the programme, while making sure that students meet the programme learning outcomes before they graduate?
- **The Responsive Blended Learning approach will be essential** to enable students to engage with practical learning experiences as part of their own cohort, whatever restrictions are lifted or imposed in specific contexts.
- This is an unprecedented situation, and **disciplinary communities are working hard to find ways of supporting practice-based learning**. This guide provides some initial guidance and resources, but your colleagues, your informal disciplinary networks, and your professional body will be important sources of ideas.

EXAMPLES OF ONLINE AND BLENDED LEARNING ACTIVITIES

Below are a few different ways that alternatives to physical labs, studios and field trips can be developed using online tools. These examples are drawn from the documents and websites included in the 'Helpful Resources' section at the end of this guide.

LABORATORIES IN STEM SUBJECTS

Home labs
For some disciplines and topics, it is feasible for students to safely carry out experiments in their own spaces. These can then be recorded and shared with staff and other students. Experiments can either make use of common household items, or home lab kits can be purchased.

Lab recordings
Experiments and procedures can be broadcast on video (either live or recorded), for students to watch and learn from. This could be done by staff or students, depending on access to lab facilities. There are vast numbers of experiments already available as videos, for example on YouTube. The use of videos on their own may result in passive students and limited learning. Activities built around videos (e.g. discussion boards, quizzes etc) can encourage more active learning, as can more creative use of lab videos such as asking students to guide demonstrators through an experiment.

Lab simulations
Online versions of lab procedures are available in different places, and in different formats. They range from simple (and free) tools where students can manipulate particular variables in order to see, for example, the effect of meteorite size, speed and composition on the size of an impact crater, through to more sophisticated (and expensive) tools that provide virtual-reality laboratories.

Remote labs
Remote labs differ from lab simulations by providing students with remote access to real scientific equipment – such as microscopes and telescopes – in order to run procedures and collect data.

Citizen science
'Citizen science' refers to the involvement of members of the public in research projects, such as wildlife surveys or the development of algorithms. If it proves difficult to provide students with other opportunities to engage in live science, these kinds of initiatives could give students valuable experience of real-world research.

STUDIOS AND WORKSHOPS IN DESIGN SUBJECTS

Social media
Standard social media platforms such as Instagram and Pinterest are widely used by students in design subjects, and they do offer the ability to share work with peers and tutors that is so crucial to studio work. There are also more specific social media tools that may be useful for sharing, collaborating, and getting feedback (e.g. Padlet) including some which are used in the professional world of design, e.g. **www.govisually.com**

Virtual studios
A number of people have developed more focused and complex social media tools, intended to provide a virtual approximation of the studio space. They build on social media by providing more formal learning activities alongside sharing and commenting functions.

FIELDWORK

Local field trips
If students are able to leave their residence, they could be set activities involving investigation of their own local environment.

Broadcasts from the field
To give students some access to locations, contexts, terrains etc., information can be shared with them in other forms. Videos may be already available (e.g. on YouTube). If staff are able to visit, they may be able to record video, audio and other information to provide to students. Staff may be able to broadcast live from the location, engaging 'synchronously' with students who are then able to ask or answer questions etc.

Virtual field trip
Virtual field trips use different ways of collecting and sharing information, to try and capture a real-world environment. Numerical data, photographs, cartography, and other kinds of information can be used to give an approximation of a physical field trip.

USEFUL RESOURCES

The following pages provide links to a range of helpful documents and websites, for STEM labs, design studies and field trips. Links are provided for: guidance documents (largely from the Open University); media articles and blog posts; practical teaching resources; and academic literature. The links are not intended to be exhaustive, they just provide a handy set of materials for busy staff to consult.

Links to videos have not been provided, as these are particularly numerous and easy to find, via YouTube for example.

LABS IN SCIENCE AND ENGINEERING

Guides to online/remote labs:

- Science in remote labs (Open University) **https://iet.open.ac.uk/file/iet-teaching-at-a-distance-08-science-in-remote-labs.pdf**
- 'Online laboratories' in Innovating Pedagogy 2020 (Open University) **https://iet.open.ac.uk/file/innovating-pedagogy-2020.pdf**
- 'Learning by doing science with remote labs' in Innovating Pedagogy 2015 (Open University) **https://iet.open.ac.uk/file/innovating_pedagogy_2015.pdf**
- Moving STEM courses online (Google Doc from the STEM special interest group of the US-based Professional and Organisational Development (POD) Network) **http://bit.ly/stem2-online-20200317**

Media articles and blog posts about lab teaching during COVID-19:

- 'How to rethink science lab classes' (Inside Higher Education) **https://www.insidehighered.com/advice/2020/04/08/five-objectives-online-science-labs-lend-themselves-virtual-teaching-opinion**
- 'What is an "online chemistry lab"?' (Michael Seery) **http://michaelseery.com/what-is-an-online-chemistry-lab**
- 'Moving a (physical) chemistry lab online' (Michael Seery) **http://michaelseery.com/moving-a-physical-chemistry-lab-online**
- 'Moving early undergraduate chemistry labs online' (Michael Seery) **http://michaelseery.com/moving-early-undergraduate-chemistry-labs-online**
- 'How to quickly (and safely) move a lab course online' (Chronicle of Higher Education) **https://www.chronicle.com/article/How-to-Quickly-and-Safely/248261**
- 'The magic of teaching science labs isn't lost online' (Wired) **https://www.wired.com/story/opinion-the-magic-of-teaching-science-labs-isnt-lost-online**
- 'I suddenly have to move my lab course online! What should I do?' (PhysPort) **https://www.physport.org/recommendations/Entry.cfm?ID=119927**

Resources to support online/remote labs

- Documents with links to multiple resource repositories
  - Resources for teaching geosciences online, including videos and virtual field trips: **https://docs.google.com/spreadsheets/d/1-R6THvCIcAjGrWRspCN915SIzItdZ95ziwiF8BmQrYc/edit#gid=0**
  - Resources for teaching labs online, from the 'Tiny Earth' initiative engaging students in antibiotic discovery: **https://tinyearth.wisc.edu/digital-labs-and-activities**
  - Google spreadsheet with online resources for science labs, collated by the POD Network: **https://docs.google.com/spreadsheets/d/18iVSIeOqKjj58xcR8dYJS5rYvzZ4X1UGLWhl3brRzCM/htmlview#gid=0**
- Individual resource repositories, primarily lab simulations and remote labs. (Some of these are free to use, however some require a paid subscription – though some of those are providing a level of free access during the current crisis)
  - **https://www.golabz.eu/**
  - **http://online-engineering.org/index.php**
  - **http://pt-anywhere.kmi.open.ac.uk**
  - **https://github.com/opennetworkinglab**
  - **https://phet.colorado.edu**
  - **http://myscope-explore.org/index.html**
  - **https://www.labster.com**
  - **https://www.biointeractive.org**
  - **https://www.ni.com/en-gb/shop/academic-site-license.html**
  - **http://www.chem.ox.ac.uk/vrchemistry/**
  - **http://stem.open.ac.uk/study/openstem-labs (see also http://www.open.ac.uk/blogs/design/using-remote-and-onscreen-laboratories-in-online-learning/)**
  - **https://www.ucl.ac.uk/~ucbcdab/simulations.htm**
  - **https://www.virtualmicroscope.org/content/uk-virtual-microscope**
  - **https://www.rit.edu/cos/interactive/MINT/ivv-list.php**
  - **https://avida-ed.msu.edu/avida-ed-application/**
  - **http://virtuallaboratory.colorado.edu/virtuallabs.htm**

Academic literature

- Balamuralithara , B. & Woods, P. (2009) 'Virtual laboratories in engineering education: The simulation lab and remote lab' Computer Applications in Engineering Education 17(1): 108-118. **https://doi.org/10.1002/cae.20186**
- De Jong, T., Sotiriou, S. and Gillet, D. (2014) 'Innovations in STEM education: The Go-Lab federation of online labs' Smart Learning Environments 3. **https://doi.org/10.1186/s40561-014-0003-6**
- McLean, S. et al (2016) 'Reflections on "YouTestTube.com": An online video-sharing platform to engage students with chemistry laboratory classes' Journal of Chemical Education 93(11): 1863-1870. **https://doi.org/10.1021/acs.jchemed.6b00045**
- Sauter, M., Uttal D., Rapp D., Downing, M. & Jona, K. (2013) 'Getting real: the authenticity of remote labs and simulations for science learning' Distance Education 34(1): 37-47. **https://doi.org/10.1080/01587919.2013.770431**
- Viegas, C. et al (2018) 'Impact of a remote lab on teaching practices and student learning' Computers and Education 126: 201-216. **https://doi.org/10.1016/j.compedu.2018.07.012**

STUDIOS, WORKSHOPS AND 'MAKER SPACES'

Guides to teaching design subjects online

- Creating distance design courses: A guide for educators (Derek Jones). **https://distancedesigneducation.files.wordpress.com/2020/06/cddc_guide_0-9.pdf**
- 'Virtual studios' in Innovating Pedagogy 2019 (Open University). **https://iet.open.ac.uk/file/innovating-pedagogy-2019.pdf**
- Maker culture (Open University). **https://iet.open.ac.uk/file/iet-teaching-at-a-distance-10-maker-culture.pdf**
- Best practices in online learning for art & design programs (Hanover Research). **https://cdn2.hubspot.nethubfs/3409306/Best-Practices-in-E-Learning-at-Art-and-Design-Institutions.pdf**

Media articles and blogs about teaching art and design during COVID-19 crisis

- 'Distance and online design education – a (not so) quick introduction' (Derek Jones, Design@Open). **http://www.open.ac.uk/blogs/design/distance-and-online-design-education-a-not-so-quick-introduction**
- 'Remotely hands-on' (Inside Higher Ed) **https://www.insidehighered.com/news/2020/04/14/teaching-lab-sciences-and-fine-arts-during-covid-19**
- 'Teaching art from a distance could have benefits' (Hyperallergic). **https://hyperallergic.com/549058/distance-learning-and-teaching-art-covid-19**

Resources

- 'Online Art & Design Studio Instruction in the Age of "Social Distancing"' Facebook group: **https://www.facebook.com/groups/onlineartanddesigninstruction/?ref=group_header**
- Resources from DS106, a MOOC on digital storytelling from the University of Mary Washington: **http://ds106.us/teaching-ds106**

Academic literature

- Fleischmann, K. (2020) 'Online design education: Searching for a middle ground' Arts and Humanities in Higher Education 19(1): 36-57. **https://doi.org/10.1177/1474022218758231**
- Ham, J. & Schnabel, M. (2011) 'Web 2.0 virtual design studio: Social networking as facilitator of design education' Architectural Science Review 54(2): 108–116. **https://doi.org/10.1080/00038628.2011.582369**
- Kwan, K. (2010) A proposal for the Web 2.0 revolution in online design education: Opportunities for virtual design learning using social networking technologies. DRS conference (Design Research Society). Montreal, Canada: 1–22. **http://www.drs2010.umontreal.ca/data/PDF/069.pdf**
- McDermott, C. (2012) Connecting contemporary designers: A study in piloting e-learning through collaborative online creative practice across UK and Korea (Kingston, ADM-HEA). **http://arts.brighton.ac.uk/__data/assets/pdf_file/0009/64539/Connecting-Contemporary-Designers-Project-2011-12-Final-Report-Kingston.pdf**

FIELDWORK (E.G. FIELDTRIPS)

Guides

- 'Geo-learning' in Innovating Pedagogy 2013 (Open University). **https://iet.open.ac.uk/file/innovating-pedagogy-2013.pdfOU**

Academic literature

- Fung, M. et al (2019) 'Applying a virtual reality platform in environmental chemistry education to conduct a field trip to an overseas site' Journal of Chemical Education 96: 382-386. **https://pubs.acs.org/doi/pdf/10.1021/acs.jchemed.8b00728**
- Cliffe, A. (2017) 'A review of the benefits and drawbacks to virtual field guides in today's Geoscience higher education environment' International Journal of Educational Technology in Higher Education 14(28). **https://educationaltechnologyjournal.springeropen.com/track/pdf/10.1186/s41239-017-0066-x**
- Spicer, J. and Stratford, J. (2001) 'Student perceptions of a virtual field trip to replace a real field trip' Journal of Computer Assisted Learning 17(4): 345-354. **https://doi.org/10.1046/j.0266-4909.2001.00191.x**

Resources for virtual field trips

- Resources for teaching geosciences online, including videos and virtual field trips: **https://docs.google.com/spreadsheets/d/1-R6THvCIcAjGrWRspCN915SIzItdZ95ziwiF8BmQrYc/edit#gid=0**
- Virtual field trips from Arizona State University: **https://vft.asu.edu**
- VR Tour Creator from Google: **https://arvr.google.com/tourcreator**
- Tour Builder from Google: **https://tourbuilder.withgoogle.com**
- VR Google Earth: **https://arvr.google.com/earth/**
- VR experiences from Penn State: **https://imex.psu.edu/experience-catalogue/**

RESPONSIVE BLENDED LEARNING

A range of support documents are available on the RBL resources page

The Supporting Students Learning Online Toolkit provides an introduction to online learning and teaching.

Further support for individuals and course teams is available from the Learning and Teaching Academy

A Special Interest Group has been created to collate ideas about how to provide online and blended practice-based learning activities. If you have creative solutions you would like to share more widely, please contact LTAcademy@hw.ac.uk

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