Hybrid Practical Work 2020/21 In School of Engineering

Prof Tim Drysdale
Chair of Technology Enhanced Science Education
School of Engineering
www.youtube.com/watch?v=MSQtI9PPjok

openEngineering Lab, The Open University UK
International & UK Awards: openEngineering/openSTEM labs

• National Instruments
  Global Engineering Impact Award 2019 (Education)
• The Guardian
  Teaching Excellence Award 2018
• Global Online Labs Consortium
  Remote Experiment Award 2018
• Times Higher Education
  Leadership & Management Award 2017 (Outstanding Digital Innovation)

"The ability to remotely connect to NI [solutions] from a mobile phone, laptop or tablet is a benefit, not just for distance-learning institutions, but for any institution with thriving practical content who wants to offer their students the maximum flexibility for group work."
  - Prof. Tim Drysdale

Practical Engineering Education Through a Web Browser
The Open University
Opinion Piece:
Non-Traditional Practical Work for Traditional Campuses


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Accepted, May 2020, HE Pedagogies

"I really enjoyed this visionary piece and look forward to recommending it once published."
- Reviewer
<table>
<thead>
<tr>
<th>Name</th>
<th>Staff</th>
<th>Students in room</th>
<th>Students online</th>
<th>Comment</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-person lab (IP)</td>
<td>present to give advice</td>
<td>real hardware</td>
<td>no</td>
<td>Can the staff members move around the lab? If not, then students will need an online means of communicating to the in-room helper.</td>
<td>Use if capacity not an issue, essential without exceptions</td>
</tr>
<tr>
<td></td>
<td>and guidance; no hardware</td>
<td>in the lab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>needed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replay demonstration</td>
<td>demonstrates using pre-recorded video and data</td>
<td>yes</td>
<td></td>
<td>Backup if lab unavailable, precense while you still can! Acts as a rehearsal for live sessions</td>
<td>Use if we are in the worst case scenario and need to have a backup plan</td>
</tr>
<tr>
<td>(RD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online demonstration</td>
<td>demonstrates using real</td>
<td>no</td>
<td>yes</td>
<td>Students can influence what happens via questions and chat data available for self-led analysis exercises afterwards (either from this session or the pre-recordings)</td>
<td>Use for any case where we wish to run the session in a way to give more students a chance.</td>
</tr>
<tr>
<td>(OD)</td>
<td>hardware in the lab</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid demonstration</td>
<td>demonstrates real hardware</td>
<td>present, no access to hardware</td>
<td>yes</td>
<td>Likely to have limited capacity for in-room students given this session will be restricted. It may still be useful to laboratories where equipment is a one-off, e.g. the testing concrete testing</td>
<td>Use when you have a single lab and some of them are remote</td>
</tr>
<tr>
<td>(HyD)</td>
<td>in the lab</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid practical (HP)</td>
<td>demonstrates using real</td>
<td>real hardware</td>
<td>yes</td>
<td>This is really two separate events running at the same time – and needs to be administered carefully. There needs to be a staff member demonstrating their equipment to the online cohort in the hybrid online demonstration style, while another staff member handles the queries that come up from students in the room, who will be doing their own</td>
<td>Use when you have some but sufficient (10) can be some independent analysis to get any students on the right path over multiple weeks so can scale accordingly</td>
</tr>
<tr>
<td></td>
<td>hardware in the lab</td>
<td></td>
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</tbody>
</table>

https://www.wiki.ed.ac.uk/display/EngIntranet/Hybrid+Practical+Work
Example: Chemical Engineering Lab 3
Daniel Orejon Mantecon (D.Orejon@ed.ac.uk)

**Face-to-Face**
- Experiment assigned & lab manual provided
- Risk assessment
- Laboratory & experiment briefing in the lab
- Undertake experiment & data acquisition
- Data analysis & assignment completion with discussions in the lab and surgery hour
- Assignment submission & feedback provided

**Visual/Virtual Laboratory**
- Experiment assigned, lab manual and on-line material provided
- Laboratory & experiment briefing via practical video
- Risk assessment
- Watch video of the experiment & data acquisition
- Data analysis & assignment completion with dedicated T&D discussion from the lab and surgery hour
- Assignment submission & feedback provided
Assignment Working Flow

Online Laboratory (Friday the week before assignment):
- Read Manual Chapter and Sections dedicated to your experiment and assignment
- Watch Online Laboratory Demonstration: Introduction, Experimental Apparatus
- Create Schematics, Risk Assessment and Blank Data Sheet
- Watch startup, experimental runs and record the data, and finally shut-down
- Create a routine (Mondays 13:00 to 17:00 and/or Tuesdays from 11:00 – 13:00?)

Work towards the assignment (during the week assigned):
- Data acquisition and Analysis including Errors
- One hour/experiment online discussion with Demonstrator on Wednesdays from the lab 11:00 – 13:00
- One hour hybrid tutorial specific to the assignment Fridays 10:00 – 11:00
  Alrick Building TLC
- Surgery Hours Thursdays 9:00 – 10:00

Work towards the assignment & submission (the week after):
- Independent Learning Hours
- Online submission by Thursday 16:00
- Note: Slides for Oral Presentation and Posters will not be submitted online.

96 students -> 4 Groups -> 5 sessions per group over 4 weeks, Microsoft Teams
Group working at home: Engineering Applications 1
Simone Dimartino (simone.dimartino@ed.ac.uk)

https://media.ed.ac.uk/media/G16+Yellow+-+Present+Beneath+the+Tree/1_gcef4nph/190276703
Real-time interactive experiments: Remote Laboratories
Live interaction with real equipment
250 students, 80% of final mark
Controls and Instrumentation 3 (course organiser Dr Aristides Kiprakis) UI by David Reid
Hybrid Practical work in Engineering

• Synchronous sessions with online and in-person planned for SEM2, with contingencies in place
  • Plans developed and implemented by Cross-School Working Group led by Tim Drysdale
    Examples
  • Video demonstrations e.g. chemical engineering course
    • Daniel Orejon Mantecon (D.Orejon@ed.ac.uk)
  • Home group work e.g. cross-school first year course
    • Simone Dimartino (simone.dimartino@ed.ac.uk)

• Remote Laboratories e.g. mechanical & electrical course
  • This activity was happening anyway, with plans pre-dating covid.

timothy.drysdale@ed.ac.uk
Extra slides
Remote laboratories – quick summary

• New pedagogical opportunities in remote and virtual labs
• Solve pressing real-world problems with our teaching constraints
• Previously built award-winning remote laboratory
• New labs for Edinburgh + world
• First usage in assessed coursework (250 students)
• Building another 50 experiments for school of engineering
• Collaborations welcome
• Intended for use across the whole University, as well as our local communities, schools, FE, and HE worldwide (eventually!)
• Open-source infrastructure for international federation and cooperation, enhancing dissemination of good practice.
Use cases

Teaching
• Students collect and analyse data for assessed report
• Students explore difficult concepts in their own time
• Students see that surprising or counterintuitive results are real
• Lecturer demonstrates principle to live audience with live experiment
• Answer a question from student with demonstration
• Students develop experiment as project
• Adapt someone else’s experiment to suit your purposes
• etc etc!

Other
• Enhance research impact and dissemination by making prototypes available remotely
• Outreach to schools and communities
• Recruitment, including widening participation (let each student explore something they like)
• Public engagement (large interactive sessions)
• Community contributions – e.g. hybrid museums exhibits
• Make the campus a playful science museum
• Inform visitors of our teaching and research by direct interaction
Scheduling concept from T. Drysdale and V. Dishon
Workshop technicians +

Learning Technology Developers + Student co-creators
Opportunities in LT & related spaces

**Course Design**
- Unpack ILO
- Identify pain points
- Identify “longed for” features
- Create new digital experiences to address these

**Deployment**
- Identify and arrange access to experiments
- Set up class lists
- (ultimately similar tasks to working with VLE on other course aspects)
- Administer and maintain experimental fleet

**Development**
- Remix interfaces written in Javascript and HTML5
- Develop experiments (e.g. Arduino + electronics)
- Install and configure software on Raspberry Pi
Why do remote laboratories?

New pedagogical opportunities:

- Student-led / reflective learning
- Authentic Assessment
- Student co-creation
- Community good
Issues we face without them

- Cost & limitations of the current provision
- Increasing class sizes
- Limited laboratory space
- Loss of “exploratory” lab time
- Lack of campus space to build new buildings
  - which would be costly
  - take years to arrive,
  - then be inflexible
Digital alternative for ALL subjects:

- Remote labs
  - Synchronous
  - Asynchronous
- Blended labs
- Virtual labs
- Simulated labs

Pedagogy
Practicality
Sustainability