Vacuum science: an inclusive training module from development to evaluation

Interim Report

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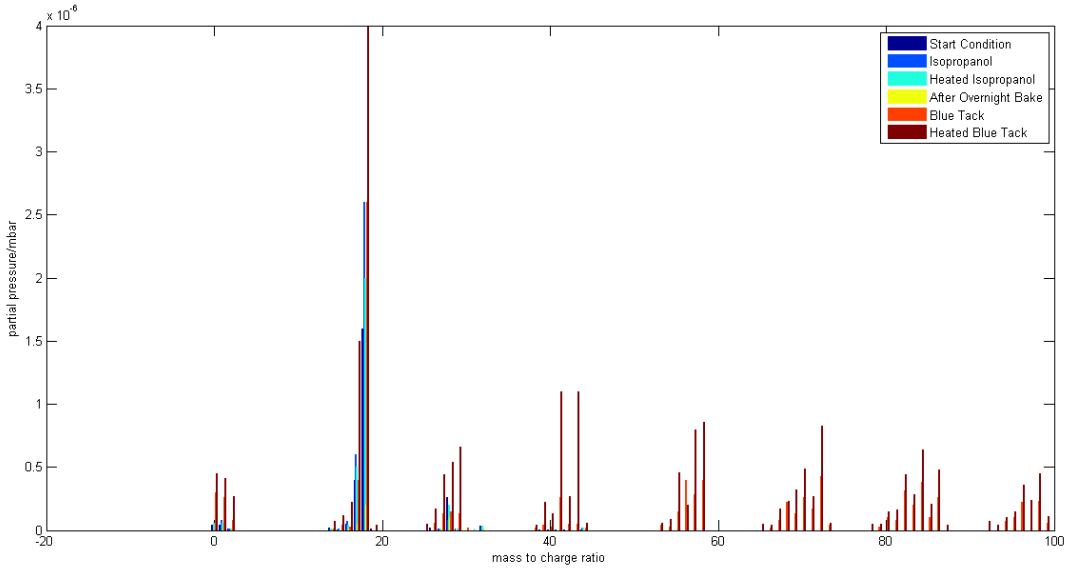
The project was arranged essentially in two parts: (1) develop and deliver a Hands-on Vacuum Science module for the Midlands Physics Alliance Graduate School (MPAGS), and (2) develop material from the online component of this MPAGS module towards an inclusive training module for all staff and students. Part (1) was completed on schedule and delivered to 10 students from Nottingham and Warwick. This was delivered by Moodle work followed by a 1.5 day practical session, which I ran using some available space in the Physics undergraduate teaching labs. The meant running the practical session after the autumn term had ended, which was not a problem for a module aimed at PhD students. The gender split was 50/50 (unusual for physics!) with most students in their first year of PhD, though some in later years up to 4th. The Nottingham students were from the Matter Wave and Quantum Optics Group research group while the Warwick students were a mix from the Condensed Matter Physics research cluster. The Nottingham students stayed in Warwick overnight – we had a small social event (beers & soft drinks & pizzas) in the evening which was appreciated by all students, who enjoyed finding out about each other's diverse research areas.

Finishing the Moodle page and quizzes in time for the course to begin was a challenge. A Masters research student in Physics helped with developing teaching material for the module, both for online (photos, web development, etc.) and practical (frames for small "teaching" vacuum systems, sorting out vacuum components, etc.), a total of about 40 hours work. Although a lack of time to complete the work satisfactorily before the practical session was noted in the student feedback, this will not be a problem next year since only minor tweaks to the online material are needed. Several students asked for help and/or feedback in completing the online assignments which was done by email or face-to-face (including in spare moments during the practicals). The hands-on days' work was not assessed, enabling a more relaxed atmosphere (some of the challenges of assessed team practical work were addressed in an interesting WIHEA Masterclass in March). Students formed teams according to their own preferences, except that I split off one Warwick team specifically, since they had significantly more vacuum experience than the other students and could attempt more challenging tasks. The tasks set built on each other, began quite focused then became more open-ended, and involved the student teams helping each other out with their developed expertise. The positive student feedback (see Appendix) suggests this approach was effective.

At the suggestion of one of the MPAGS students, after the practical session we took a group photo with members of the class who didn't have to rush off, holding our spanners aloft! On the practical day, we completed a nugget of student-led research – one of the themes of the practical session was "things NOT to do with a vacuum system". A common problem is people using materials which are incompatible with vacuum, the worst offender being Blu-Tack. We looked at the "mass spectrum" of Blu-Tack in a small student-built vacuum system. As far as I am aware this has never been published before. The data are shown above – the clusters of peaks on the right of the graph confirm that Blu-Tack is a polymer material which easily falls to pieces in the vacuum, contaminating it severely with hydrocarbons.



I attended the main UK vacuum technology meeting in October at which there are several vacuum technology teaching sessions. These do appear to be mainly talk-and-powerpoint with little hands-on work or opportunity for formative assessment. I think there remains a gap in the market for the kind of vacuum course originally envisaged. Part (2) was originally planned to involve Diamond Light Source, a major international scientific facility based in the UK which relies heavily on vacuum technology. Unfortunately my collaborator at Diamond is not able to participate in the project and so this aspect has been put on hold. I have briefly discussed broader student needs around vacuum science with Warwick colleagues in Life Sciences, Engineering, Chemistry and the Microscopy RTP (met through IATL/WIHEA/Window on Teaching or known personally). This will need to be expanded to small scale student consultations to see what material (and at what level of technical complexity) would be suitable for the inclusive module. It would also be valuable to assess training needs for technical staff, in the context of career development as part of Warwick's Technician Commitment [1]. I would also like to talk to the Student Union education team about their view of inclusive teaching for online content. Another approach to exploiting the work done on the MPAGS module for Part (2) of the project, still aimed at a more interdisciplinary STEM cohort, is to investigate the possibility of developing a module for the Analytical Sciences Centre for Doctoral Training. This has been discussed informally with the CDT lead, Professor Steven Brown, and I will follow up over summer.

Notes, tips and reflections on the project so far

- Getting a dedicated Moodle page set up for MPAGS was straightforward, arranged by the IT Services Moodle team directly.
- Non-Warwick students can be registered temporarily with IT Services to access Moodle. This is a reasonably simple procedure which was smoothed by (1) registering multiple students in one ITS call and (2) obtaining blanket HoD permission (required) for the whole academic year then referring to the original IT call number instead of generating repeated emails to a busy HoD!
- To make most of the video content, I bought a small foldable photo studio (cube-shaped, 60cm on a side)[2] – this proved ideal for showing various vacuum components with voice-over and could be done in my office using a basic digital camera. Sound quality with the camera mic was perfectly acceptable after a bit of experimentation with positioning.
- Moodle seems a bit fussy about video formats and eventually I settled on the webm format made from the camera's AVI files using the Convert/Save option in the (free) VLC media player [3].
- I have not yet found a simple and reliable way to auto-subtitle the video content, which is important from the point of view of inclusivity.
- Cross-departmental and cross-institution work (e.g. MPAGS) is always challenging and tends to fall into the cracks in terms of teaching organisation. Explicitly cross-departmental groupings such as WIHEA and IATL are really essential in finding local contacts, etc.
- The project is proving a very nice way to focus my own learning and CPD in online-based teaching, inclusivity, student research and assessment. Examples:
    - Window on Teaching – Student as Researcher 7/3/19
    - WIHEA Masterclass – Peer Assessment (students in project teams) 3/4/19
    - University of Kent online course on Inclusive Teaching [4]
    - Upcoming WIHEA Masterclass: Authentic Assessments and Online Learning
    - Upcoming Moodle Module Effective Practice Workshop

Notes and references

[1] https://sciencecouncil.org/employers/technician-commitment/

[2] Available from Onecall, catalog # PY32094

[3] https://www.videolan.org/vlc/

[4] https://www.lexdis.org.uk/course/inclusive-teaching-and-learning-strategies/

Appendix – Feedback on the MPAGS module

3 students gave written feedback (below). Verbal feedback emphasised how useful and enjoyable the practical hands-on work was, and that it was good to meet and work with fellow PhD students from another institution. Several students mentioned that the material learned in the online work made much more sense when the theory was applied in a real lab setting.

1. I think the content was good with an appropriate workload and assessmnet, although I do think that some more example and practice questions for calculations would give a better understanding of some of the mathematics involved and a feeling for how it can be applied in a useful context. I really liked the online resources such as the recorded explanatory videos and the animations showing the functioning of the various pumps and vacuum gauges, they were very helpful tools for understanding how the devices function. The delivery was excellent and enthusiastic which made the hands on days very enjoyable and productive. It was easy to ask questions and thorough answers were provided. I think the timetabling was quite good and with a better understanding of what equipment will be needed (as this was the first time the module was ran) I think the time allocated is appropriate. One problem was that the moodle resources only got sorted quite late and so I didn't have time to get through much material before the practical days and got less out of the practical session than I could have.
2. The content is rich with the very useful practical information required for the course. I liked the videos as well. I think that the Moodle assessment is quite heavy, but the material is very handy. Moreover, the fun enjoyable training environment was awesome, and it was a very good opportunity to know our peers, the PhD students in other different universities. I hope the practical work could longer.
3. Thanks for organising this module. It has been thoroughly enjoyable and extremely useful, especially from the practical point of view. Your teaching was very good, informative and helpful during the vacuum lab work. I hope other students will benefit from this module in the future as much as I did.