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| About us - IOP Publishing | SUN Workshop  **Teaching Practices / Case Studies**  Institute of Physics, London  Monday 8th July 2019 | https://img.evbuc.com/https%3A%2F%2Fcdn.evbuc.com%2Fimages%2F42580300%2F2177762368%2F1%2Foriginal.jpg?w=800&auto=compress&rect=0%2C0%2C800%2C400&s=ad390e38614767757398d3791baf3f8f |

# Workshop Summary

The 2019 SUN Workshop was held in partnership with the Institute of Physics Higher Education Group, and hosted by the IOP at their London headquarters. Spacecraft engineering and space science are areas that attract highly motivated students who seek employment in the rapidly evolving space sector. A challenge for educators is to deliver engaging and authentic learning that develops the skills and knowledge needed by the sector.

This workshop was designed to explore and share examples of good practice and provide an opportunity to network with staff in engineering, physics and earth observation seeking to enhance teaching in space topics.

Following an introduction to SUN by Ian Raper and to the IoP Higher Education Group by Mark Jones, the morning was occupied with three presentations on case studies developed by SUN members. There was also an opportunity for attendees to give a 2 minute pitch for teaching ideas they were looking promote or seek collaboration on.

After lunch, the event split into discussion groups so that attendees could discuss the case studies from the morning with the presenters. This allowed a deeper exploration of the idea and to address specific questions. This was followed by a presentation on the ESA\_Lab@ initiative from Jason Maroothynaden.

# Case Study Presentations and Discussions

Note that these case studies, and others submitted by SUN members, are available on the SUN website under Resources (<https://www.spaceuniversitiesnetwork.ac.uk/resource-bank>).

## Astrodynamics Mission Simulation Case Study

Nigel Bannister, from Leicester University, provide a presentation on the use of GMAT for astrodynamics simulation. (GMAT is freely available mission analysis software developed by NASA.) Students are expected to present their work in the model, rather than PowerPoint, which allows interactive discussions and means students really have to understand their use of the data.

Students are given a two hour walk through to teach them how to use GMAT. Then the students have enough basic skills to continue on for themselves. The students get a workbook which has 14 mission scenarios (exercises), with some notes per exercise. Tutorials are to help with the GMAT framework and the workbook. The class is limited to 30. GMAT is available to download from the NASA Software Catalogue (https://software.nasa.gov/software/GSC-17177-1).

Orbits associated with Mars can be used as the ‘numbers’ are known and available in the literature. Here the aim is for the student to validate, i.e. do they get the same answer. In discussion it was suggested that the SUN Resources group could look at hosting GMAT files that could provide others with a starting point for their teaching.

## Fly Your Thesis

Pau Cuartielles from Cranfield University presented on using the ESA academy for “drop your thesis” using the Bremen drop tower.

Projects cover a timeline of about 1 year, and experiements have a success rate of around 50%. ESA covers costs to access facilities + 5K for students’ travel and accommodation. Experiments are designed, proposed and run by students (with supervisor’s guidance). These experiments need to be quite simple as the budget is very limited.

## Mars Rover simulation

Mark Jones, from the Open University, covered the use of Mars rover simulation. The simulation uses a physical Mars yard with data from real sources (archival data from MSL Curiosity), so when students do the investigations, the real data is being provided as the results. The mission has realistic energy and data budgets and decisions need to be made to maximise scientific return.

Students are supplied certain reading and encouraged to read these sources before starting. The academics are experienced in this scenario and they can help students to make appropriate decisions since mission planning is a particularly important aspect of the simulation. There was some workshop discussion of how such a simulation exercise might be extended, e.g. if a second rover could be included in the simulation, then the teams would need to decide which modules, which instruments etc. according to their costing.

Students are given a project with goals (e.g. to catalogue rocks on the Mars surface to look for evidence of past or present water). They need to plan operations, collect and analyse data within a time limit (about 1 week). They connect to the robot and can manoeuvre it around the Mars yard. Students work in a team and their results are reviewed at the end of the challenge.

HEFCE funded the capital equipment and the development: two software designers wrote the package. The simulation is all online. The module is run as a 60 credit module using 1 whole week out of 32 weeks in the academic year. Two members of staff help each group. It is a lot of hard work to support the students – very demanding, but the students report that it is a valuable learning experience.

# Launchpad – two-minute pitches

Before breaking for lunch the opportunity was provided to all attendees to give a two minute pitch on something they were doing, or wanted to start, to look for others who might also be interested. The following pitches were made:

* Matt Whyndham (UCL) highlighted their current development of case studies to be used in teaching, and sough co-authors and domain experts for assistance in developing a case study in life support infrastructure system.
* Jenny Kingston (Cranfield) mentioned their Concurrent Design Facility which is being offered as part of ESAs 2019 Conurrent Engineering challenge.
* Peter Shaw (Kingston) revealed that they are building a rocket laboratory to fire 1.5kN thrusters, and they would like to reach out and collaborate with others.
* Alison McMillan (Wrexham Glyndwr) raised PhD study: what associated skills and further learning could feed into Postgrad professional development that would bridge or signpost science/engineers into space careers?
* Lucy Berthoud (Bristol) brought up Curriculum redesign particularly for first year with the aim of ‘authentic active learning’. How do we encourage our lecturers to change from the ‘sage on the stage’ to the ‘guide on the side’ with cohorts of 160+?
* Kate Smith (Manchester) highlighted the use of CanSat in an undergraduate engineering programme, with an offer to share lessons learnt for others that may be thinking of exploring this approach.
* Ian Raper (UCL) covered introducing objects into the lecture to improve student understanding of the anatomy of a spacecraft. Looking to see if there is interest for a community of practice / sharing ideas / help! Where can I get some objects.

## ESA\_Lab@

Jason from the Business Applications Department within European Centre for Space Applications and Telecommunications of ESA where he looks for programmes where new jobs can be created, e.g. data – commercial applications, AI, IT and where business applications and space solutions can be combined. This included helping startups from the beginning.

The ESA\_Lab@ is where ESA is looking to partner with universities in a joint inititative. The activities can bring together multiple universities as part of the network. The outputs can include papers, coneferences and events. The ESA\_Lab@ works on the basis of no exchange of funds, but looks for mutual benefit between ESA and the organisation. ESA are currently in discussion with UCL, Imperieal College, Oxford and Lancaster.

# Workshop feedback

Feedback from the event was provided by 14 of the 23 participants. All respondents are involved in teaching space-related topics at university level, and the majority (11) were members of SUN. The indication is that the meeting met its key aim in that all respondents either strongly agreed (64%), or agreed (36%) that it was useful or helpful in informing their teaching.

The meeting aimed to share good-practice and foster collaboration, so it was good to see that 93% said that they would take some of the ideas from the workshop into their teaching, and the same number (93%) also agreed that the meeting had been useful in establishing potential collaborations related to teaching.

Feedback comments, such as “Fabulous day - lots of interesting ideas” and “[it] was a useful day - to see things I wouldn't have thought much about otherwise” indicated that the dissemination of teaching ideas was appreciated by participants. The mixed format of the programme also seemed to be well received, with comments such as, “the format worked quite nicely, in particular the opportunity to chat with the specialist speakers”, and, “the ‘2 minute pitches’ part was very useful for quickly highlighting ideas… [and] … to identify people to talk to further”.

As for ways to develop the workshop, it was suggested that perhaps there should be a little more emphasis on the impact of innovative ideas on teaching and learning rather than on their technical implementation. It was also noted that having one or two high profile speakers might help to draw people in and make this a bigger event.

There were various suggestions about future events. A couple of respondents noted that a workshop focussing on projects between institutions (either to initiate, or report on such projects) would be helpful. It was also remarked that discussion of teaching related to satellite applications should also be covered.

Overall then, this appears to have been a well-received and enjoyable event characterised by one participant with the statement, “always good to have the time-out from the day-to-day to be inspired.”

*Please note: if you detect any errors or omissions in this summary, please send an email to i.raper@ucl.ac.uk*