Research projects from home: what skills do students acquire outside the labs?

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Why we formed this panel:

To engage the audience in a discussion with a hope of generating **cross-pollination of ideas** and collating an **overview of good practices** from across fields.

Introductions

- Sara Ghoreishizadeh
  Aspire-CREATe and UCL Div. of Surgery & Interventional Science
  Module: SURG0161

- Michael Thomas
  London Centre for Nanotechnology & Dept. Biochemical Engineering.
  Module: BENG0070

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  Aspire-CREATe and UCL Div. of Surgery & Interventional Science
  Module: SURG0095

BENG0070: Bioprocess Research Project
BSc Bioprocessing of New Medicines & MEng Engineering

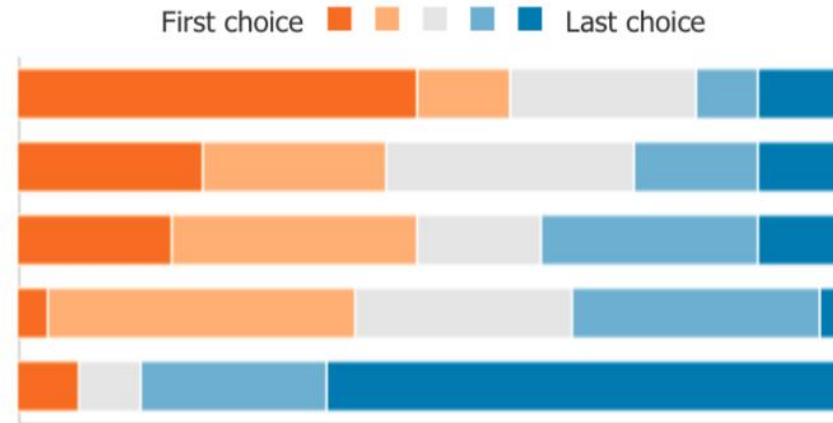*Ca. 36 students at L6 and L7. Two streams within each focused on science / business.*

- Projects typically fall within the remit of Biochemical Engineering but staff cover a broad range of disciplines

- Some lend more readily to remote formats (e.g protein modelling, reactor modelling, multivariate data analysis

- Others are more challenging (e.g synthetic biology, cell culture, tissue engineering).

- Typically projects straddle computational/practical work. Small experimental elements may be key to supporting a more dominant computer-based project for example.

BENG070 – Pandemic Project Planning

1. What kind of Research Project would you prefer? Please rank with your top choice at the top.

More Details

Rank	Options
1	Laboratory-based project
2	Critical literature review
3	Simulation/computational/dat...
4	Any desk-based
5	I don't mind

First choice ■ ■ ■ ■ ■ Last choice

Several streams on BENG0070 – different desires focused around employability and what constitutes "research". Lots of time was invested in explaining how research and the "scientific method" drives all project types.

"throughout my degree I realised that I am not very comfortable with computational design and analysis, so I would strongly prefer working on a laboratory-based research project which I feel more comfortable with"

"My primary career aspiration is to enter academia and carry out research. **One of the most important aspects of academic research is the synthesis of new information from pre-existing sources**. Therefore, a critical literature review will allow me to further develop my skills in this area whilst providing the perfect stepping stone towards my

"Firstly, I find that lab-based projects are much more unique and allow you to acquire a lot more knowledge than desk-based projects. Secondly, I have only had
a few laboratory sessions so I would like to practice my **lab skills more before graduating to increase my employability**."

BENG070 – 2020-21 ILOs

Demonstrate a practical aptitude for laboratory research	Not Met
Gain basic research skills, become confident users of relevant equipment and learn experimental techniques	Partially Met
Design experimental plans and exercise creativity	Met
Organize, analyse and present data with statistical analysis	Met
Draw accurate conclusions from the data obtained and compare with the published literature	Met
Present research findings in a technical report	Met
Prepare a scientific poster and discuss the results obtained with an expert audience	Met

1. Demonstrate a practical aptitude for laboratory research

- Typically we provide a spread of project types:
- Laboratory-based (various formats) (ca 50%) - - - *Not available for 20/21*
- Computation/Simulation/Data Analysis (ca 40%) - - - **20/21 (ca 60%)** *encourage use of old data or data generated by PGR.*
- Literature Review (ca. 10%) - - - *20/21 (ca 40%) aimed for systematic literature reviews.*

2. Gain basic research skills, become confident users of relevant equipment and learn experimental techniques

- In 20/21 relevant equipment became computers / remote access.
- Experimental techniques predominantly limited to those usually found in C/S/DA projects

3. Design experimental plans and exercise creativity

- For systematic reviews this became a general "methods plan" to cover experiments and search methodology. Students given a lot of flexibility to define scope and establish methods.

4. Organize, analyse and present data with statistical analysis

- Well met for all projects apart from literature review. Promoted systematic literature reviews and blended projects (part literature review to inform simulation for example). Many staff found systematic literature reviews very hard to propose in their areas. ACC Engineering UG final year project support very helpful alongside scientific writing course (Dr. Sunny Baines), and UCL Library Skills resources.

Have others experienced pushback on the value of literature review research projects vs. Practical/computational?

Challenges in helping staff adapt to remote project proposals?

Please add any thoughts to the chat.

SURG0161(L6, 30 credits, 16 students)
BSc in Medical Science and Engineering

-The project should answer a research question or test a hypothesis generated by the student. It can be undertaken in one of the following areas:

- 'wet/bench' or 'dry' laboratory science
- engineering design, manufacture and testing
- In-silico modelling

-This is a cross-Faculty (Engineering & Medical Sciences) module: 4 UCL Departments and 3 UCL campuses.

- ILOs are formulated so they are generic and apply to diverse project topics.

- Normally all project are *non* desk-based* projects.

*non desk-based project: a project that requires work/interaction with a non-domestic substance or an equipment other than a computer

SURG0161 – 2020-21 ILOs

Intended Learning Outcome (ILO)	Met ?	Why/how?
1-Understanding the overarching research process	**Yes**	-
2- Understand how research questions and hypotheses are generated and present these in a concise way (oral presentation)	**Yes**	-
3- Develop subject and technique specific skills (e.g. laboratory techniques, design techniques)	**Partially**	Mainly limited to desk-based techniques where more focus is given to either literature review, design, or data analysis. Students developed skills in these areas but not necessarily the lab/technical skills. Only **2/16** projects had practical elements.
4- Gain subject specific knowledge	**Partially**	The lab/technical skills could only be acquired through following online lab simulators. The know-how and technical knowledge could be acquired through discussions with supervisor and team members (e.g. attending group meetings) but not through experience.
5- Communicate findings in the form of a scientific poster and presentation and thesis	**Yes**	Poster assessment was online where examiners met and assessed students individually. The students then had a "poster party" to discuss their poster with each other.

SURG0161- ILOs on Research and data skills

- **1) "Understanding the overarching research process/Gain subject specific knowledge"**
- There are lectures/lessons on what research is, core research criteria, and typical steps in conducting a research project.
- Students write an "inception report" on the rationale of their study. They also plan their project (tasks/deliverables/milestones) and receive feedback on their plan from supervisor and module lead.
- Students are invited to attend departmental monthly research webinars & video recordings of these are made available to them. They are invited to the annual Student Research Symposium.
- Supervisors invite students to their research group meetings which allows the student to further observe and understand research process >> increasing overall contact hours

- **2) No ILO directly on "data analysis", However, students are asked to perform appropriate analysis of data and report this w/ appropriate interpretation"**
- Students were taught basic statistics in a previous module. Moreover, the weekly "Supporting Sessions" covers topics such as statistics.
- Students were shown how to present data + examples of good/bad data presentation

SURG0095 – 2020-21 ILOS
MSc in Rehabilitation Engineering and Assistive Technologies

- **Critically** identify and evaluate **work published** by others associated with their field.
- Identify **gaps in the knowledge**, conduct **requirements analysis** and formulate appropriate (realistic, timely, relevant) project aims;
- *Plan an **experiment or product development protocol**, including data collection and appropriate analysis*
- ***Produce** design/software/hardware to a given quality specification (not always applicable)*
- **Critically test and evaluate** their own work, including interpretation of statistics if applicable
- Propose **future areas** of development
- **Present their work** in written and in oral form to a critical audience
- **Manage their time and resources**, including optimising their interactions with their supervisors

SURG0095 – 2020-21 ILOS

Critically identify and evaluate work published by others associated with their field.	Met
Identify gaps in the knowledge, conduct requirements analysis and formulate appropriate (realistic, timely, relevant) project aims;	Met
Plan an experiment or product development protocol, including data collection and appropriate analysis	Not met
Produce design/software/hardware to a given quality specification (not always applicable)	Partially
Critically test and evaluate their own work, including interpretation of statistics if applicable	Partially
Propose future areas of development	Met
Present their work in written and in oral form to a critical audience	Met
Manage their time and resources, including optimising their interactions with their supervisors	Met

SURG0095 – 2021-22 ILOs

- Critically identify and evaluate work published by others associated with their field

- Identify gaps in the knowledge, conduct requirements analysis and formulate appropriate (realistic, timely, relevant) project aims

- *Develop a method to achieve the aim with set resources (time, budget, equipment,...).*

- Critically test and evaluate their own work, including interpretation of statistics if applicable

- Propose future areas of development

- Present their work in written and in oral form to a critical audience

- Manage their time and resources, including optimising their interactions with their supervisors

SURG0095
How did students acquire "Research Skills"

ILO: "Gain basic research skills / Understanding the overarching research process/ Develop a method to achieve the aim with set resources".

- Term 1 module on "Scientific Enquiry in Rehab Eng": students write report based on their individual project, the learning from one module is put into practice in another.
- Module lead highlights the importance of these skills and placing them in a broader context, beyond Academic Research.
- Message: core research skills are not technical, hence can be acquired even with remote projects. Our MSc trains engineers, not technicians.

SURG0095
How did students acquire "Data Skills"?

ILO: "Organize, analyse and present data with statistical analysis / Appropriate analysis of data / Interpretation of statistics"

- Also linked to SURG0091, but teaching of statistics is an ongoing challenge.
  - We have limited resources within the Centre, and a range of projects that require a breadth of statistical methods.
  - Most text books and online courses available (incl UCL's) are either very generic (means, average,…) or too specific.
  - Above all, students struggle with interpretation of statistics
- This is a recurring challenge in our programme, not related to whether a project is remote or in situ.
- Remote projects: some used existing data, others are collecting single data sets and working on n-of-1 designs.
- How do you do it?

Challenges

Challenges of remote, or "limited lab access", projects

Research project module leads, together with their programme teams, face two challenges:

a) Conceiving projects that can safely be conducted remotely and enable the students to meet the ILO

b) Conceiving projects that we have the resources to deliver, Resources are:
- Supervisory staff expertise,
- Dedicated staff if the project relies on technical procedures to be conducted for the student (either because the students are remote or have limited access, or the procedure is too complex for students with limited training),
- Budget

Student Survey

Student's perceptions of Research Projects conducted remotely.

This survey will help us better understand your experience of your individual projects this year. With your input, we will improve our modules. We also intend to present this data at the UCL Learning and Teaching Conference. Your answers are entirely ANONYMOUS from the onset, your name is not stored at any stage in the form.

Questionnaire
Question 1

1. Here is a list of Intended Learning Outcomes (ILO) that are sometimes associated with individual research projects in UK universities. Please select those that you think you have acquired this year (if your project is still ongoing, please consider what you expect to have learnt, by the time you have completed your project and received the feedback on your assessment). Please tick all that apply.

- [ ] Understanding of the overarching research process

- [ ] Critically identifying and evaluating work published by others associated with the field

- [ ] Understanding how research questions and hypotheses are generated and present these in a concise way

- [ ] Identifying gaps in the knowledge and creatively formulate appropriate (realistic, timely, relevant) project aims

- [ ] Developing subject and technique specific skills

- [ ] Gaining subject specific knowledge

- [ ] Proposing future areas of development

- [ ] Communicating scientific work to a critical audience (could be oral presenation, report, poster,...)

- [ ] Taking ownership of project, managing time and resources, including optimising interactions with supervisors

Questionnaire Question 1&2

1. Here is a list of Intended Learning Outcomes (ILO) that are sometimes associated with individual research projects in UK universities. Please select those that you think you have acquired this year (if your project is still ongoing, please consider what you expect to have learnt, by the time you have completed your project and received the feedback on your assessment). Please tick all that apply.

2. Here is the same ILO list again, please now select those that you were expecting to acquire based on the information provided on your module (this can be information on your Moodle page, input from other students, from the module lead, from your supervisor). Please tick all that apply.

Questionnaire Questions 5&6

5. Please give your overall experience of your project: 1 = bad, 2 = neutral, 3 = good. There is a free text question just after to explain your choice.

   1   2   3
   ○   ○   ○

6. Please explain why you gave this rating.

   Enter your answer

Students opinion

Average Project Rating: Good (2.6)

Questions	
a	Understanding the overarching research process
b	Critically identifying and evaluating work published by others associated with the field
c	Understanding how research questions and hypotheses are generated and presenting these in a concise way
d	Identifying gaps in the knowledge and creatively formulating appropriate (realistic, timely, relevant) project aims
e	Developing subject and technique specific skills
f	Gaining subject specific knowledge
g	Proposing future areas of development
h	Communicating scientific work to a critical audience (could be oral presentation, report, poster,...)
l	Taking ownership of project, managing time and resources, including optimising interactions with supervisors
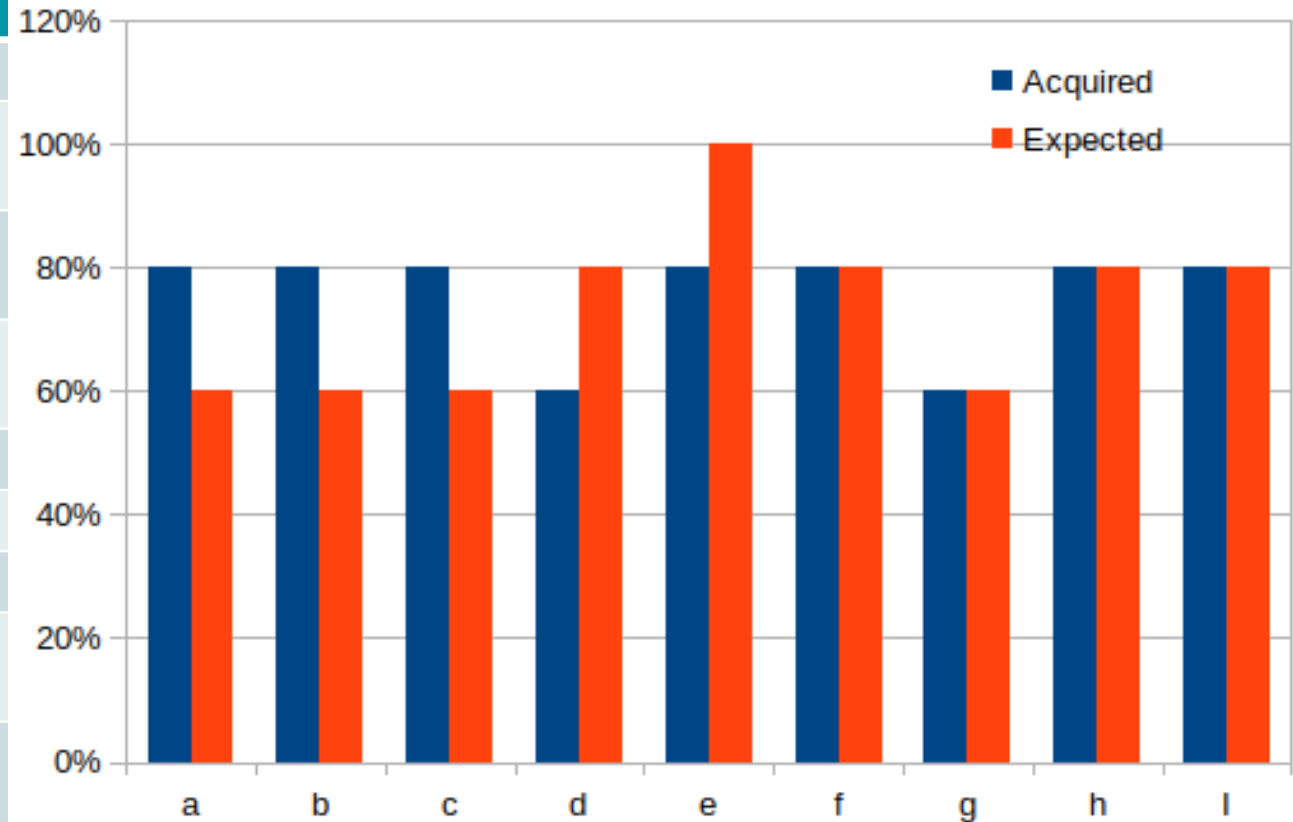
Breakdown of answers from a few students

Student k

ILO expected but not acquired

- Critically identifying and evaluating work published by others associated with the field;
- Identifying gaps in the knowledge and creatively formulating appropriate (realistic, timely, relevant) project aims;
- Proposing future areas of development;

ILO acquired though not expected

- Understanding of the overarching research process
- Understanding how research questions and hypotheses are generated and present these in a concise way

Project rating: neutral

Students m and n

ILO expected but not acquired

- None

- Developing subject and technique specific skills

Project rating (both students): good

ILO acquired though not expected

- Understanding how research questions and hypotheses are generated and present these in a concise way;

- Critically identifying and evaluating work published by others associated with the field;

Free text answers

Remote learning pushed the importance of regular meetings and ensured better tracking of what progress had been made. It was a lot **clearer about supervisor availability**.

Comments and shared documents allow for **greater communication** and are a very important tool for group working or sharing ideas.

I have a **great supervisor, and second-supervisor**, they are very engaged and discussion is simple with them. They will not hesitate to tell me if an idea is wrong or not adapted to the project and that allows for **faster progress**.

I got the freedom to **redo my project question** and make it into something **far more valuable** as part of contingency planning. My only thought would be I wish there was **greater flexibility** and less of a rush to enable **more original and tailored projects** in term 1.

I am doing a **practical project**, I was able to purchase the necessary equipment to complete my project.

Both of supervisors are really engaged, organised, supportive and give constructive feedback.

Thank you for your attention

We hope you have questions, comments, suggestions,...