An Interactive Online Lab Environment to Support Undergraduate Practicals

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Context

Coordinator for Organic 3 chemistry labs 2016

- 100 students, 5 experiments
- 4 demonstrators / markers

Chance to innovate?

What students told us…

"I had no idea what I was doing when I started the experiment"

"Wish we got more feedback on lab reports, and how to improve."

"Lab reports are too time-consuming, and there's way too long before they're marked."

"Marking is totally inconsistent."

Plan to interact and engage

Work with students to provide pre-lab films, simulations and auto-graded online reports

- Address student feedback
- Provide engaging lab environment
- Build confidence before experiments
- Provide consistent marking
- Deliver detailed feedback

Acquiring funding

Involved staff and students from the start

- Outlined possible benefits based on scholarship
- Wrote grant proposals:

  ALDinHE and College Science & Engineering

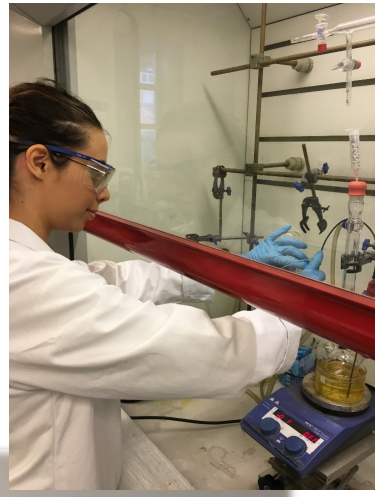
- Students: innovation, fresh perspective, and valuable skills
- Consultation with and partnering Learning Science Ltd.

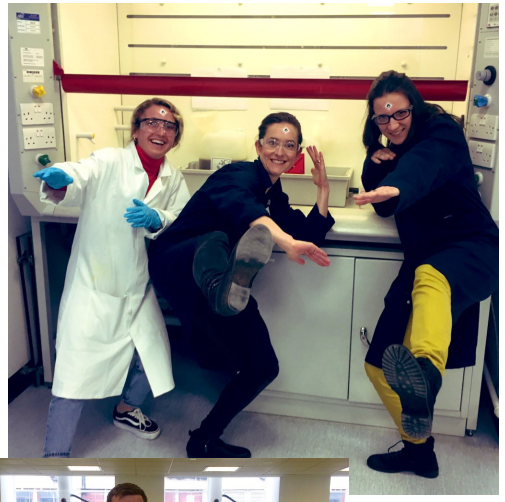
Front loading the work…

Delivery 2017/2018
Staff, students and Learning Science tested resources

ORG-3 Expt 1	Smart Worksheet		https://docs.google.c		
ORG-3 Expt 1	Smart Worksheet	Comment from Maddy	https://docs.google.c		
ORG-3 Expt 1	Smart Worksheet		https://docs.google.c		
SYN-1 Expt 3	Smart Worksheet		https://docs.google.c	26/07/2017	Fixed to accept scientific not
ORG-3 Expt 2	Smart Worksheet		https://docs.google.c		
ORG-3 Expt 2	Smart Worksheet		https://docs.google.c	11/08/2017	Added +/- 2 limits to each sh
ORG-3 Expt 2	Smart Worksheet	This cell doesn't seem to be accepting an answer in the template.	https://docs.google.c	11/08/2017	Fixed
ORG-3 Expt 2	Smart Worksheet	Because I can't submit a value for Peak 2, all other peaks are locked. They should be independent of previous peaks?	https://docs.google.c	11/08/2017	Fixed
ORG-3 Expt 1	Moodle Questions	Moodle questions for Org3 Exp1 and I think a good one to reinforce what the students learn in lectures in Year 3 would be to ask them to draw the mechanism (with curly arrows) for the reduction of citral to geraniol (E-isomer) with sodium borohydride.			
SYN-1 Expt 7	Smart Worksheet	Please make this 30% ethyl acetate in petro	https://docs.google.c		
ORG-3 Expt 1	Smart Worksheet	Dr David France's feedback from test emailed to Madeleine			
ORG-3 Expt 2	Smart Worksheet	Dr David France's feedback from test emailed to Madeleine			
	Smart Worksheet	For all experiments good to distinguish (using colour perhaps) between the calculations "answers" which have 4s.f. and the final answer, which is usually 2d.p.			

Front loading the work…





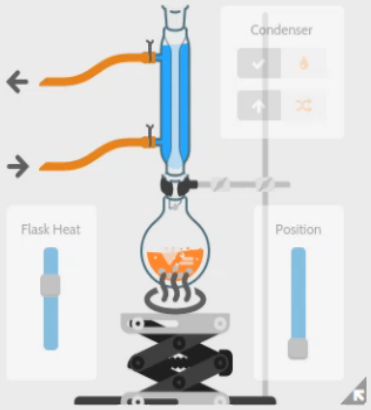
Interactive online resources

Reflux

In this exercise, you can practise setting up and performing a reflux experiment.

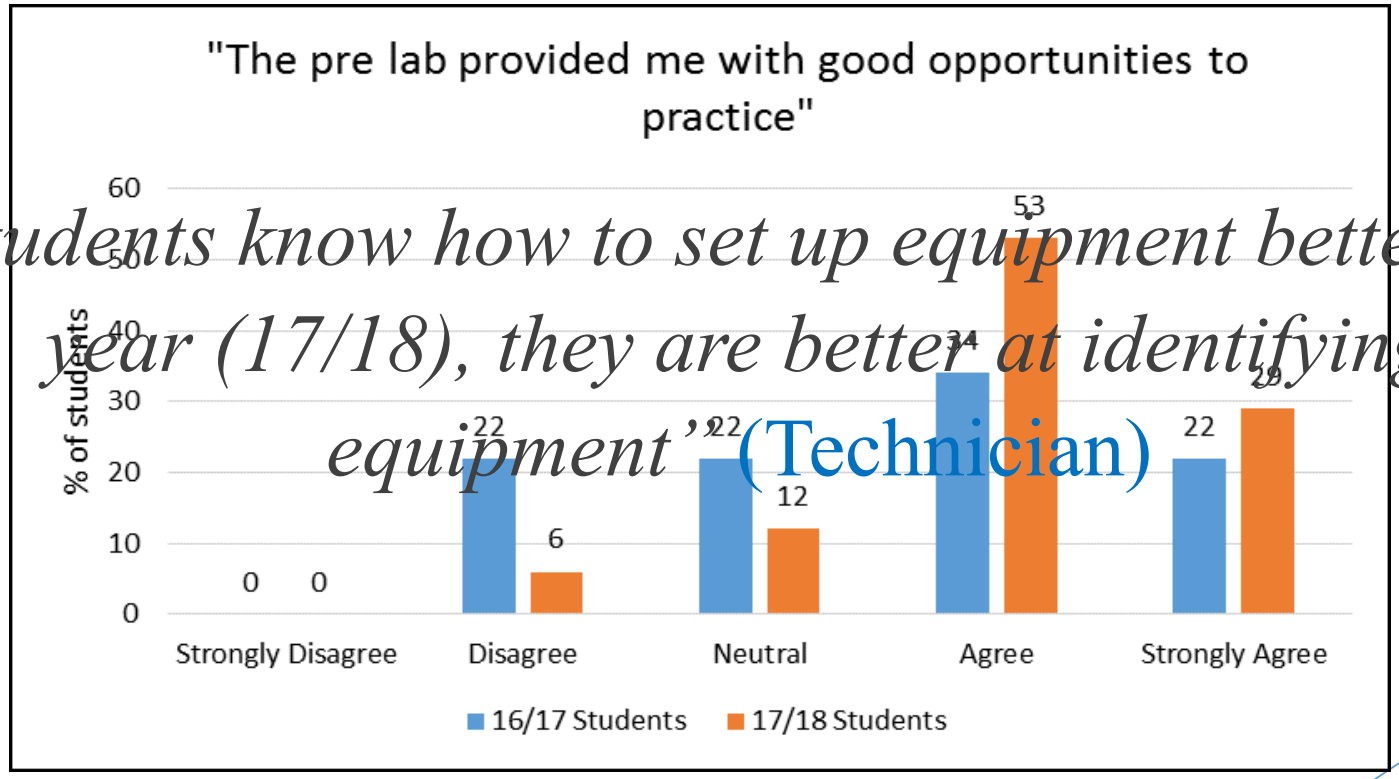
You will need to set up the apparatus safely and securely and use the appropriate level of heating so that your reaction mixture boils gently and the vapour condenses back into the reaction vessel.

By working through the exercise, you will become familiar with the equipment and how it should be used. This is your opportunity to explore different options and to understand the consequences of your choices. At any stage, you can get specific feedback about one element that requires attention and an indication of how many others need changing.



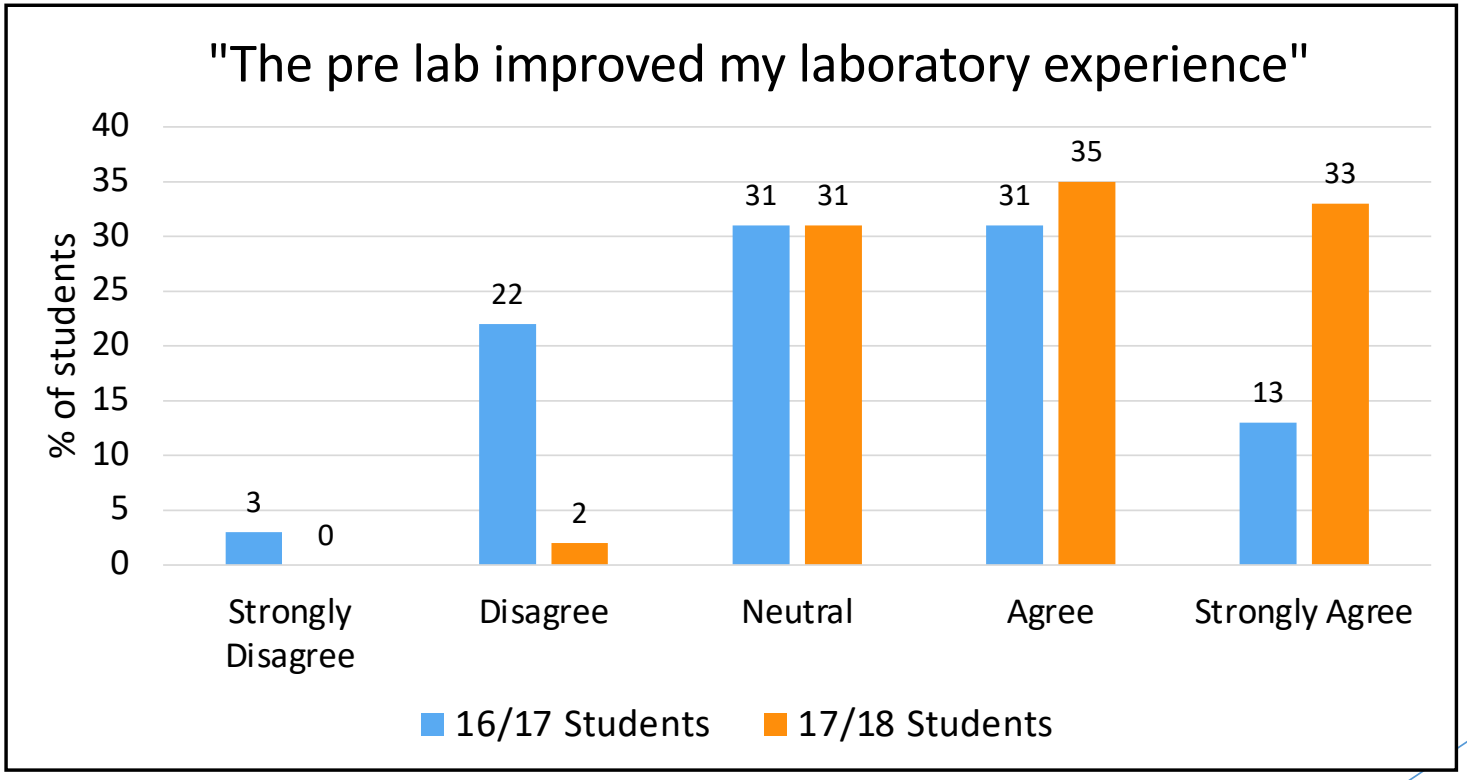
Start

Pre-lab results



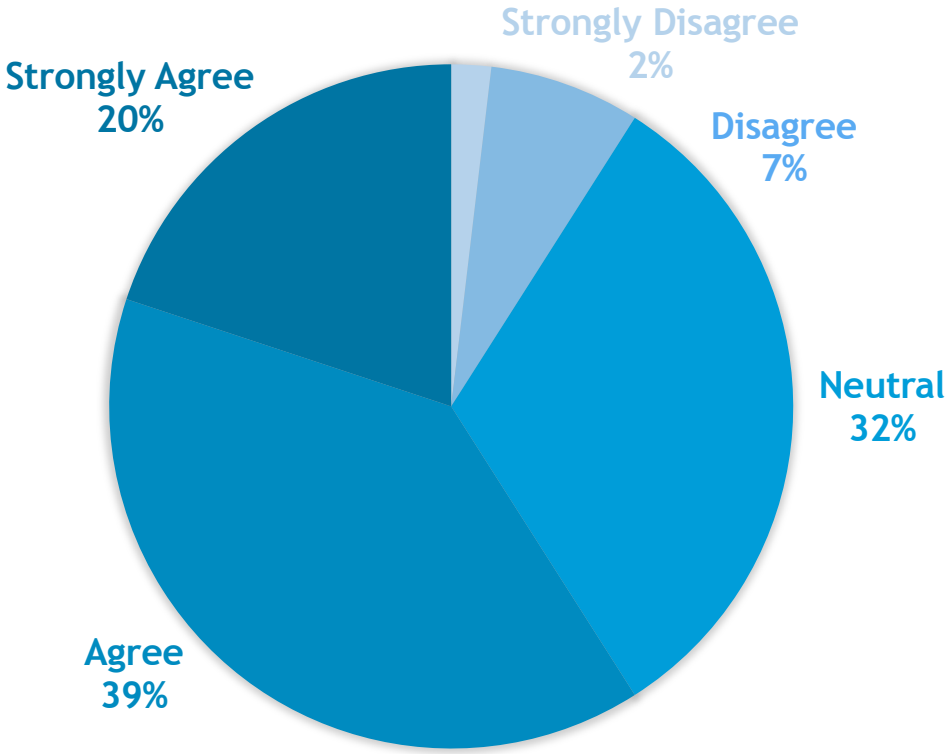
"Students know how to set up equipment better this year (17/18), they are better at identifying equipment" (Technician)

Pre-lab results



Pre-lab results

"I think that similar pre-lab resources should be provided for other courses." 2017/2018 Students



Auto-graded online reports

Question 2

Not yet answered

Marked out of 1.00

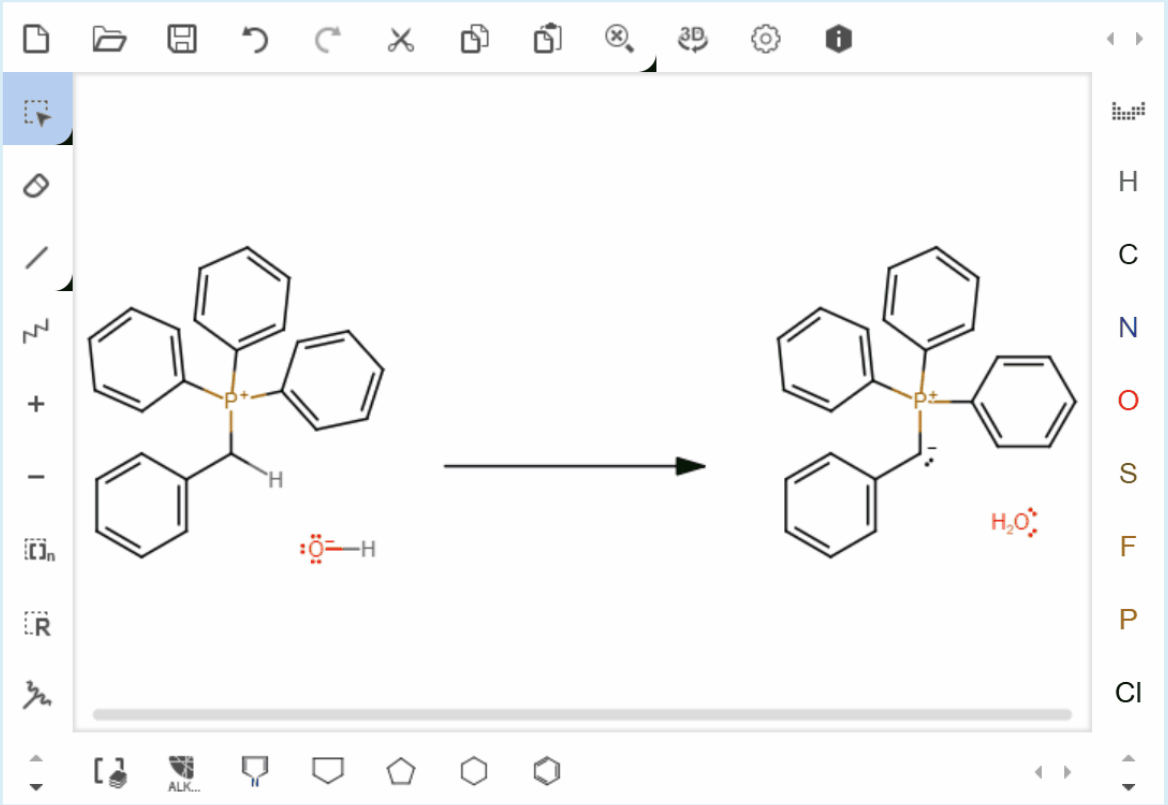
Flag question

Edit question

Draw the mechanism for the formation of the triphenylphosphine ylide from triphenylphosphonium chloride and sodium hydroxide.

Read the instructions in the previous information section before attempting this question.

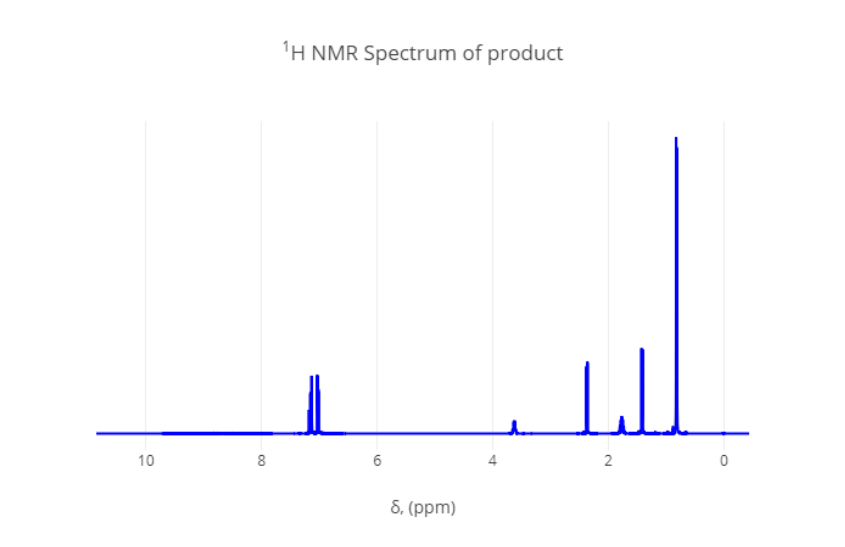
Answer:



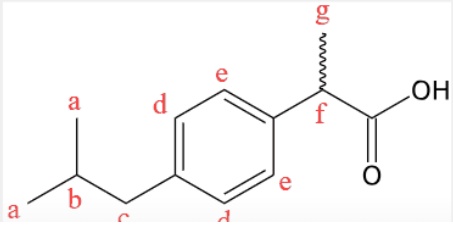
^{1}H-NMR SPECTRUM

The ^{1}H NMR spectrum of the pure ibuprofen product, recorded on a 400 MHz spectrometer, is shown below. Use this spectrum for the subsequent analysis.

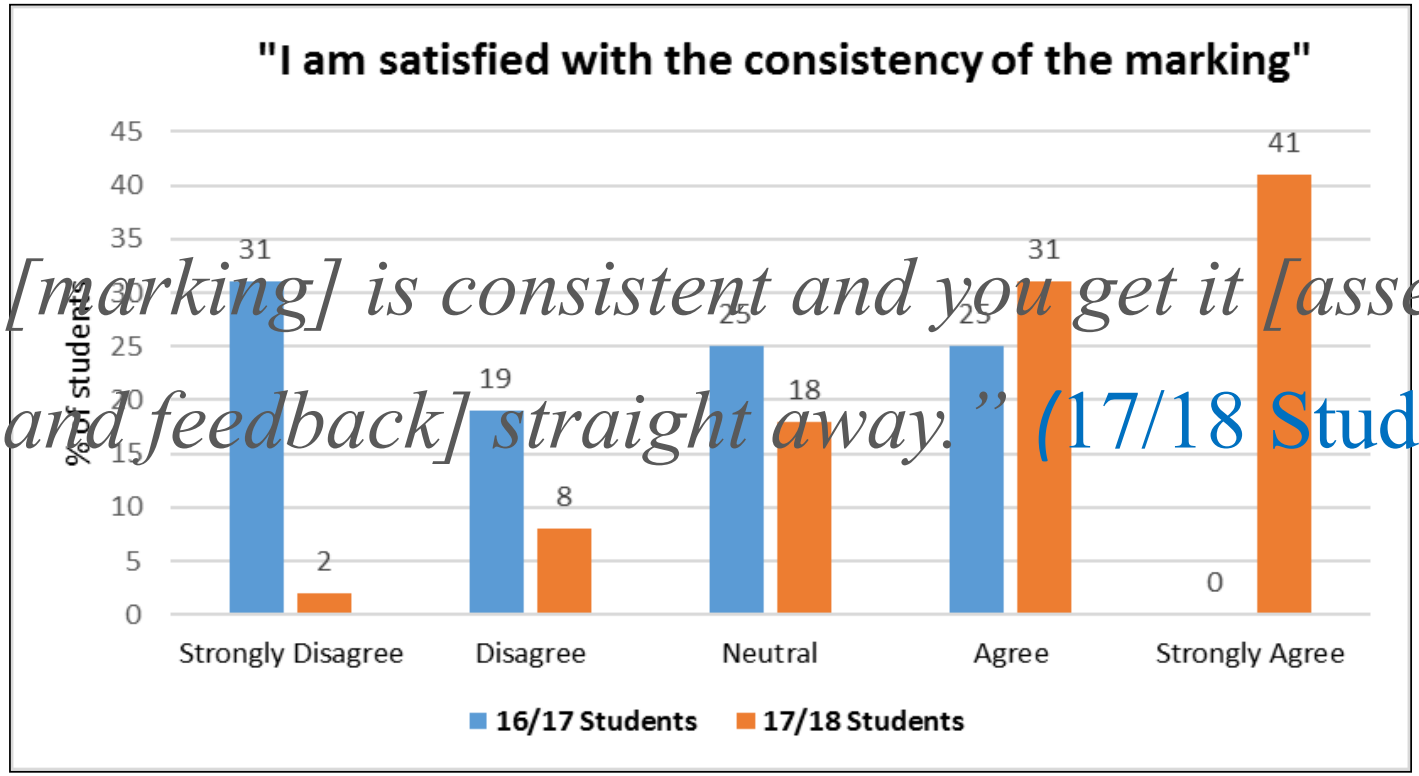
- You can zoom in to an area of the spectrum by click and dragging over the area you want.
- You can zoom out by double clicking anywhere on the spectrum.



Record the chemical shifts of the labelled peaks in the ^{1}H-NMR spectrum of your product, referencing the labels in the chemical structure below. Record the splitting pattern of the peak as either singlet (s), doublet (d), triplet (t), quartet (q), or septet, and give the J value where appropriate.

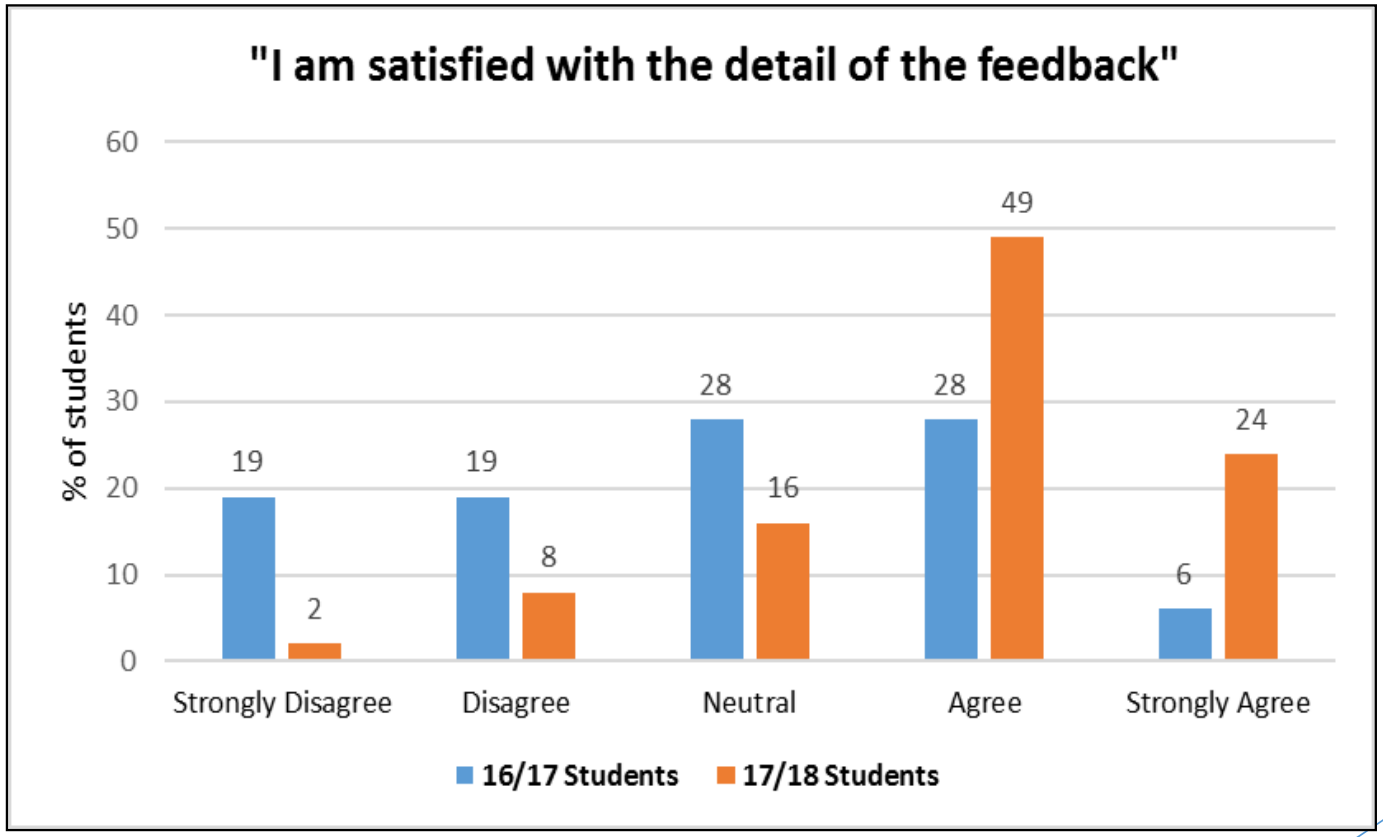


Post-lab results

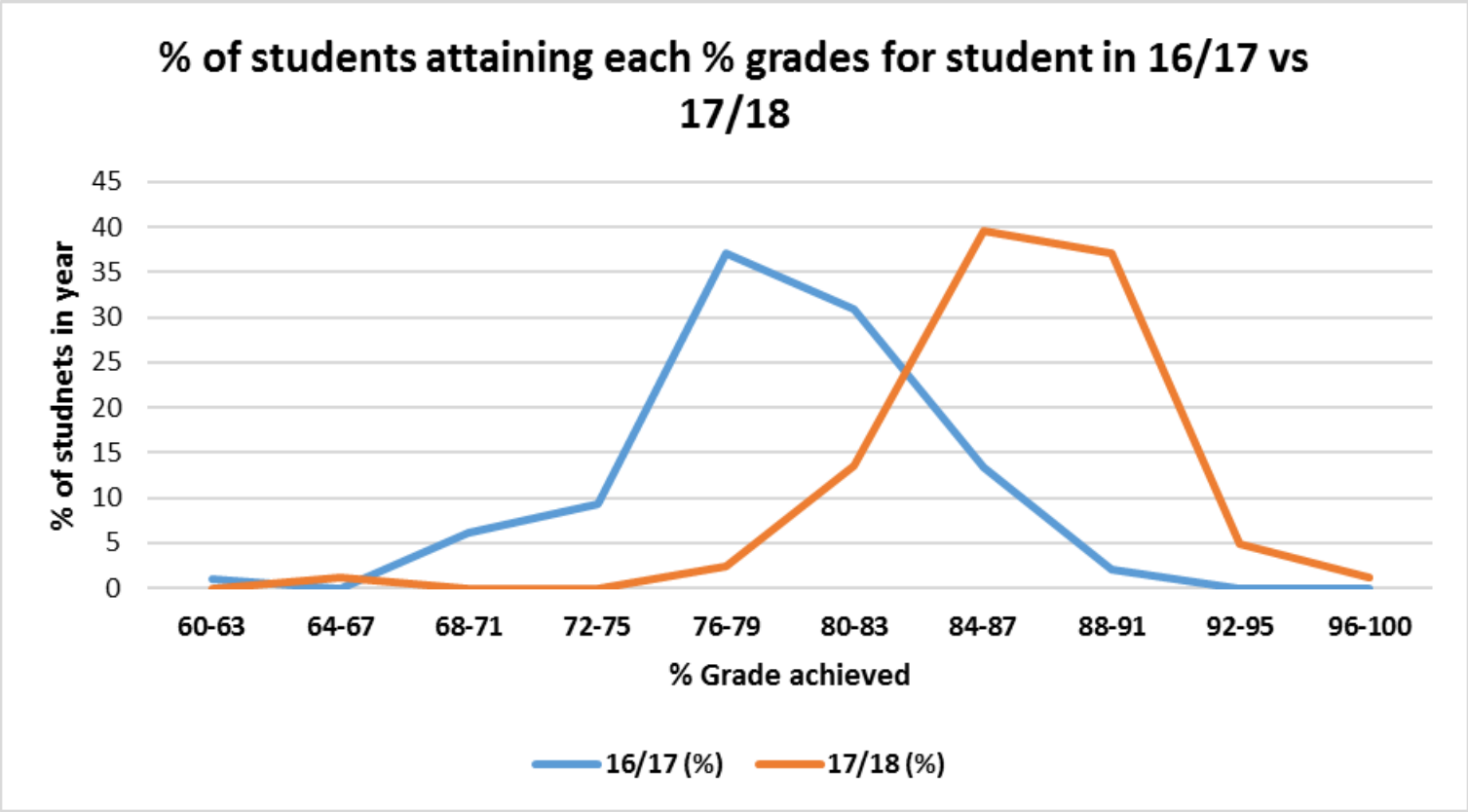


"It [marking] is consistent and you get it [assessment and feedback] straight away." (17/18 Student)

Post-lab results



Post-lab results



Conclusions & thoughts

1. Interactive online lab environment has improved student confidence, proficiency, and satisfaction.
2. Working with students and Learning Science brought innovation to the lab.
3. Student co-creators gained valuable transferrable skills.
4. How do we ensure students still practice important “write-up” skills?
5. Can we improve/align lab experiments? Move towards more inquiry-focussed?

Thanks

All the students involved

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Methodology

Before the practical laboratory
Relating to the pre lab resources:

5. The pre lab provided me with good opportunities to practice *

	4	5	
	◯	◯	Strongly agree

	1	2	3	4	5	
Strongly disagree	◯	◯	◯	◯	◯	Strongly agree

Focus Groups

Online Questionnaires