A fluorescence microscopy image showing several cells. The cells are stained with a green fluorescent marker, and there are distinct red fluorescent spots or regions within the cells, likely representing specific organelles or proteins. The background is dark, making the green and red signals stand out.

Recipes or revelation?

Influence of laboratory experiences on students' perceptions of bioscience research

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Laboratory classes fulfil many important functions, but do they give undergraduates a misleading impression of what it is like to be a bioscientist?

Does it put them off considering a bioscience career?

Imperial Biochemistry UG reflecting on 1st & 2nd year lab practicals:

A: They give us a lab schedule which we can read before hand usually, In the first 2 years we were given it in advance so we could have a look at it and understand the concepts and why you do certain steps and then after that we'll go down to the lab where the lecturer will demonstrate and explain certain concepts and how things are done and then the lab techs will help us if we need any help. It's pretty procedural, we just execute whatever's written on the sheet so I think that's how it's done.

Interviewer: What's your feeling about that?

A: I think it's not ... a very good model of real research work because what's happening is we're just executing things. I mean you can think about it and wonder about why certain things are done a certain way. You can also go through the entire lab not really thinking and you'll do fine I think. There's not a lot of personal planning involved. Like we don't have to plan the experiments based on a problem which is what I would expect would be a more realistic kind of situation where you're presented with a research problem and you think about how you're going to solve it and all the alternatives but what's happening now is we're just given a list of instructions we need to follow. I don't really know how this can be improved because at that level we don't know enough.

Interviewer: What is the purpose of those practicals then?

A: I guess it's to familiarise us with different techniques involved, different key skills.

Realising research is **creative** and **has no 'right' answers** is transformative, and can be considered a threshold concept (Meyer & Land, 2006)

Students often do not experience research until their final year project, when they may already be set on other paths.

Can we design laboratory practicals experienced earlier in the degree that better simulate real research

- My attempt is a mini-research project module within a 6-week Cellular Neuroscience course for 35 3rd-year UG Biochemists.
- It aims to give students **freedom to design and execute their own research** in small **groups** within a **guided framework**.
- Students have **ownership** of and a **stake** in their practical ,and the chance to experience something of what it is like to be a bioscientist.
- Allows them legitimate peripheral participation in our bioscience research community of practice (Lave & Wenger)

Key features

Interactive **experimental design** phase

- 2.5 days of experimental design tutorials

- Scaffolding - framework – balance

- Groups negotiate aims and plan experiments

- Present plans for peer feedback

- Complete calculations (dilutions etc)

Wet lab phase

- Up to a week

- Each group executes their unique plan

- Manage own equipment and solutions

Analysis & writing up phase

- Data analysis lectures and tutorials

- Writing-up tutorial – how to write a scientific paper

Assessment – Write-up in form of scientific paper (90%),
plan (10%)

Research project 2007/2008:

“Influence of different types of laboratory experience on Imperial Biochemistry students’ perceptions of laboratory practicals and bioscience research”

Longitudinal – beginning and end of third (final) year

Questionnaires (Likert & open-box responses)

Interviews (8)

Of 110 students **final-year students**, 40 completed the 1st and 39 the 2nd questionnaire (35%).

[72% of respondents had prior experience working in a laboratory!]

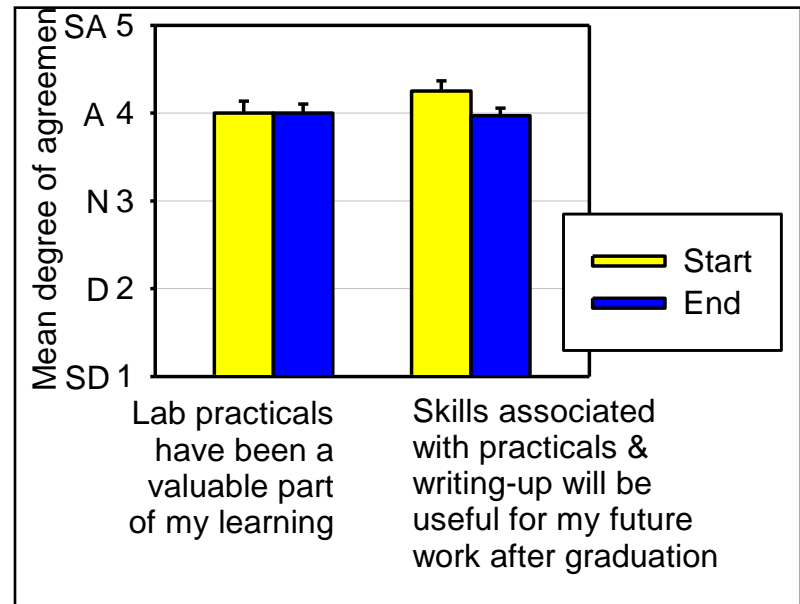
Asked about 1st/2nd-yr practicals, 3rd year practicals, CNS research project, final-year project, work experience.

[Thumbnails...]

Laboratory practicals

Students **highly value** lab practicals – top score

No significant difference in the scores for 1st/2nd year practicals and 3rd year practicals.



[Value 3rd year] “Coming to understand something yourself is a more thorough way of learning than being taught it. Soft skills (teamwork, time management, presentation skills) are covered by practicals”

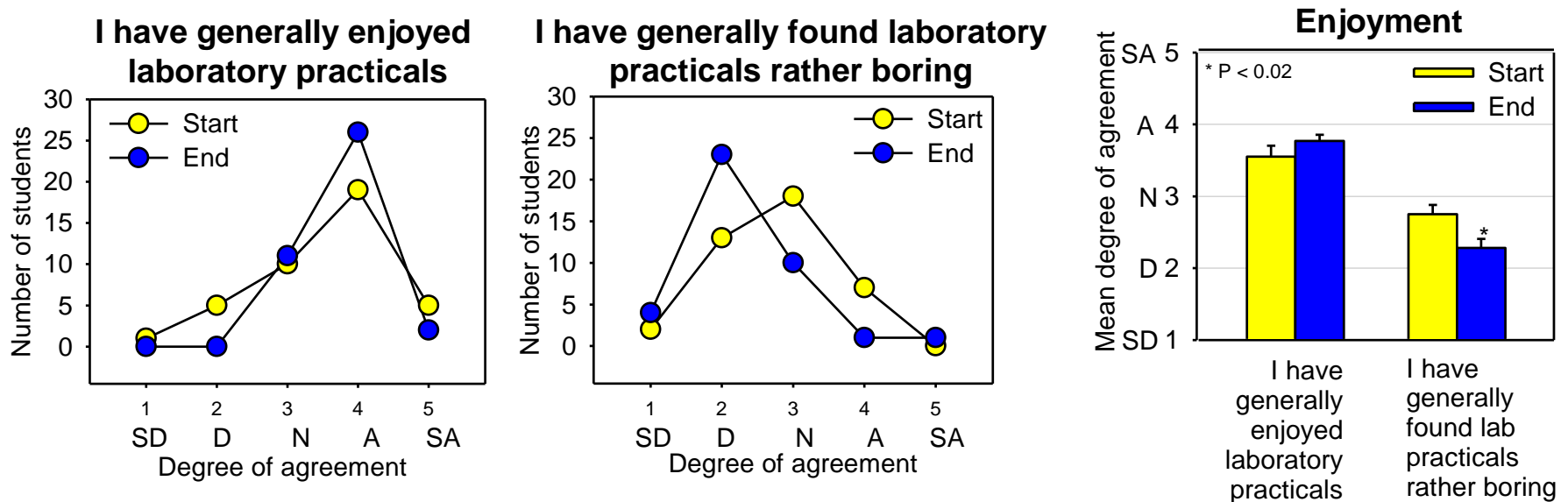
But...

[1st/2nd yr] “I like the practical work as it illustrates what is learnt in lectures, however it would be nice if you got to think a bit more instead of just following a schedule.”

Enjoyment

Enjoyment scored positively, but not as high as value, and did not change.

Neutral on whether boring, but students found practicals **significantly** less boring in the 3rd year compared to 1st/2nd yr

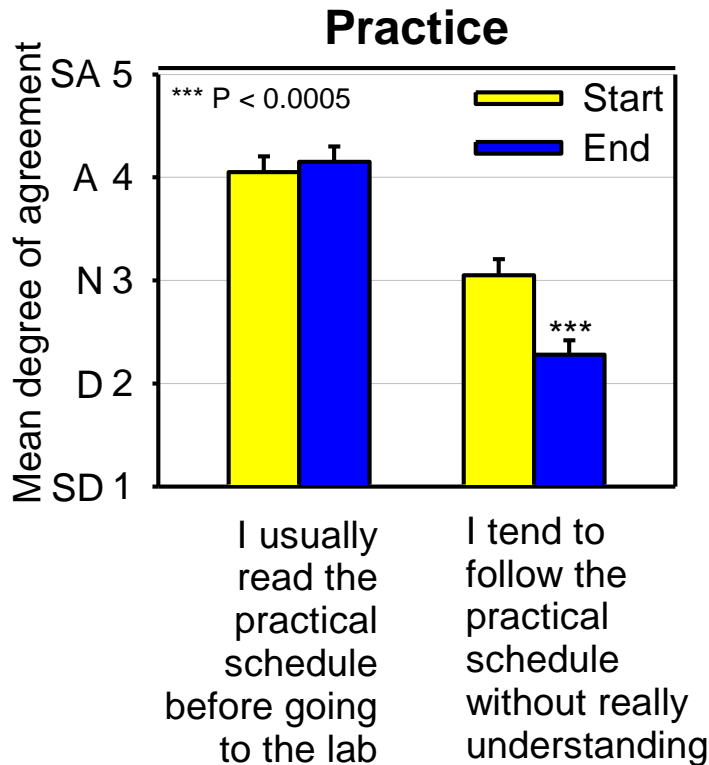


[1st/2nd year] *“Reading through a list of what to do step by step does not make it interesting, as all our work is forced throughout the experiment and you are generally not doing anything which seems exciting”.*

Practice

Nearly all students read the practical schedule in advance in all years... **BUT**

Many students follow the schedule without really understanding, but this decreases significantly in the 3rd year



[1st/2nd year] “You can go through the entire lab not really thinking...”

[3rd year] “I put more effort into planning and understanding the practical since we had to plan our own strategy.”

CNS Mini-research project laboratory practical

- Very highly valued by students.
 - **“Opportunity to design your own experiment”** was the most highly valued aspect....
 - ...followed by **“Detailed guidance & feedback”** ...
 - ...and **preparation for Final Year Project”**

“I thought it was a very challenging practical since we designed it on our own and had to think about every step and decision we made. Liked it because instead of passively performing experimental procedures, in this practical we had to think of what we were doing right from the start.”

“Usually we are just given instructions we may not fully understand whereas here we had to be more innovative which in the end helped us understand the experiment more.”

Description of course to 2nd-year student:

“Independent work, different from 1st and 2nd year practicals as there are no correct answers and you are marked based on your analytical skills and how you present your raw data and make the best out of it. Need to be able to use the literature to help make sense of the raw data”

[quite a good description of what we do!]

“You get to design your own experiment within constraints – so you’re not left to design literally whatever you want. There’s lots of guidance from [tutor], as well as peers in the discussion of your plans. During the experiment you are given lots of helpful advice from [tutor] and demonstrators. Overall you will enjoy!!!!”

“Cross-linking our experiment with the results of other groups also gives a sense of perspective and added information about the research.”

Final-Year Project

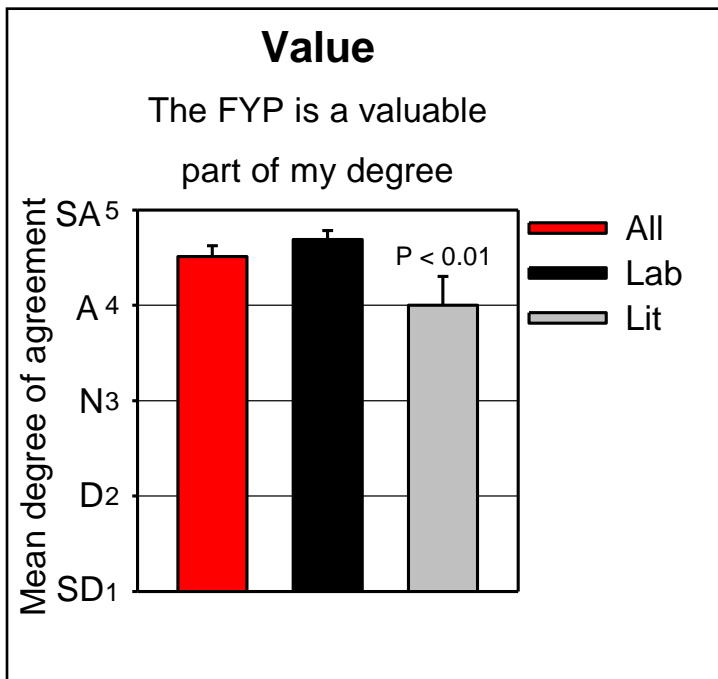
Students do a 6-week full-time research project in their final term, after their final exams.

They can choose to do a laboratory project in academic staff research groups, or a literature project.

70% chose lab projects (this is the norm each year)

Results

Highly valued by students (top score). Less so by Lit students.

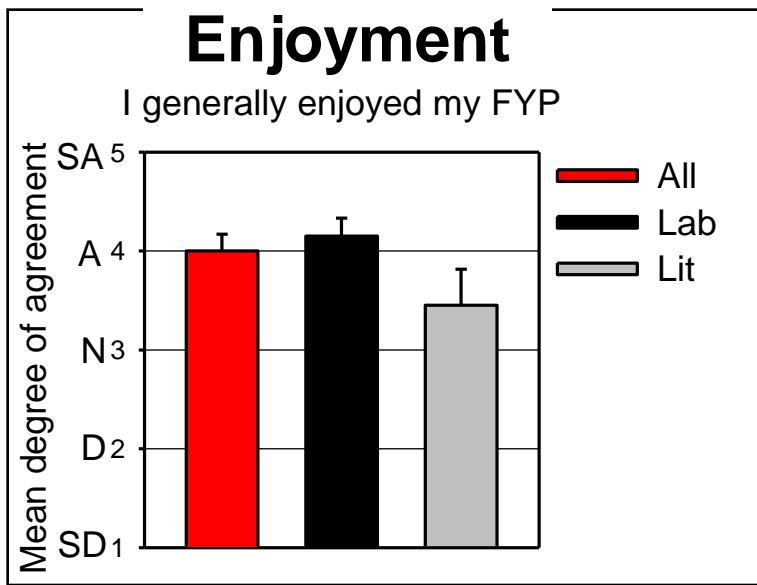


One of the main reasons given is:

- Gives insight into or experience of what bioscience research is like.

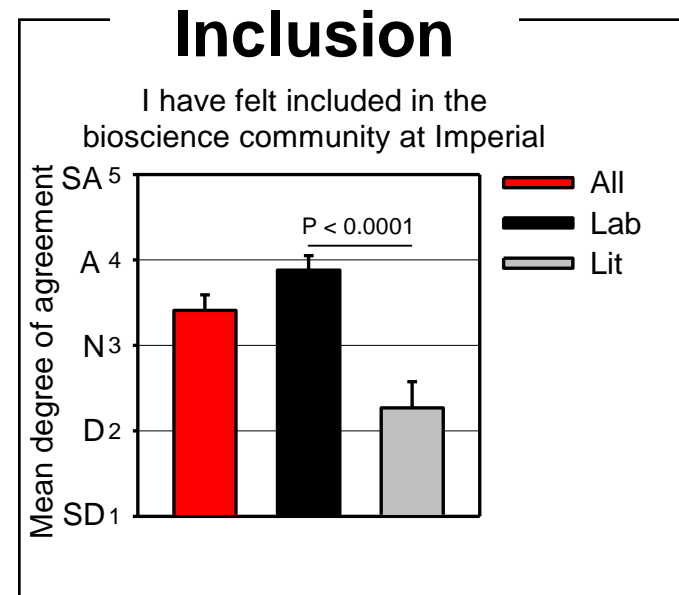
“It taught me what the real research is all about.” (Lab student)

“Gives a good insight into how we view everything we have learnt since day 1” (Lab student)



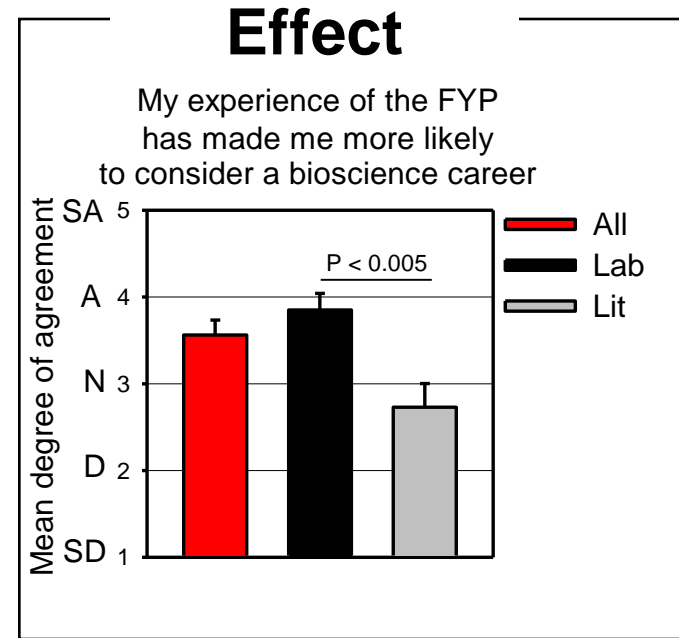
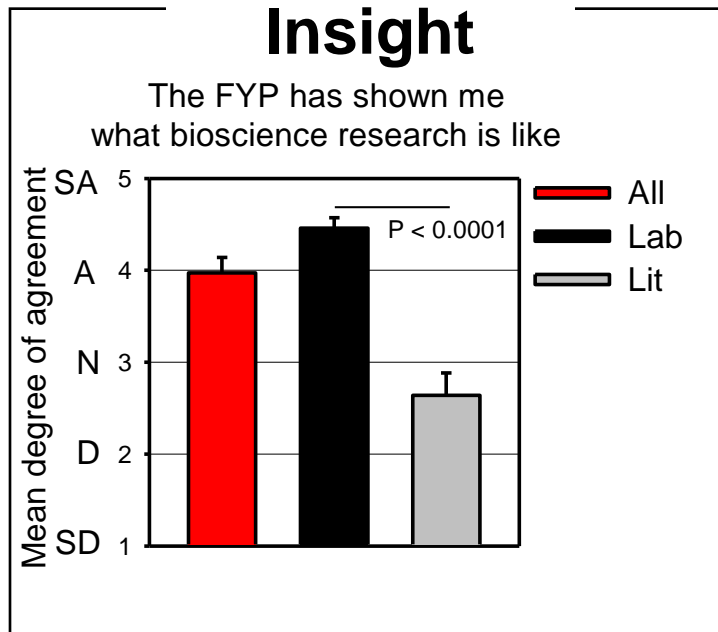
Most common reason for enjoyment was **freedom & independence**

“I had a good supervisor and I was given freedom and independence ...I was allowed input into the direction the research was going.” (Lab student)



“Discovered new things during the project. Felt like I was in the team even though only for 6 weeks” (Lab student)

“No contact with anyone else in the ‘community’ apart from the supervisor.” (Lit student)



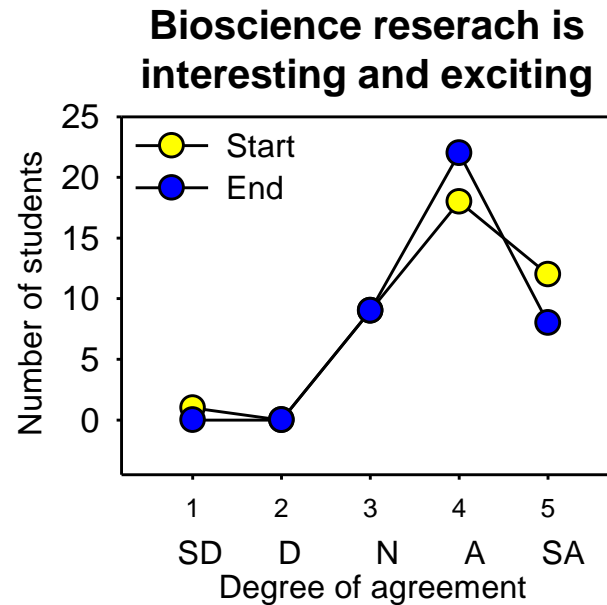
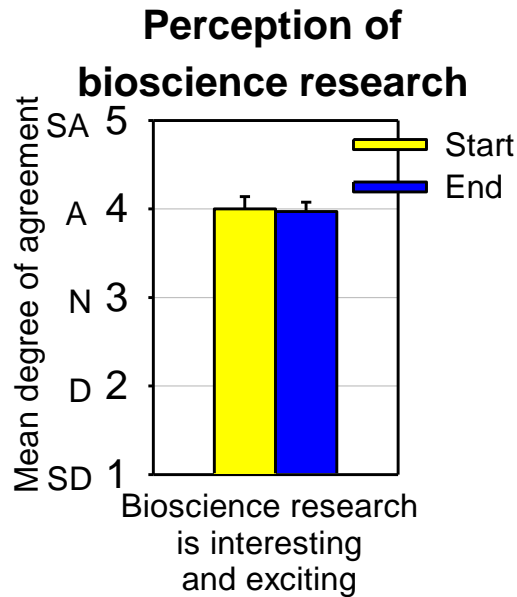
“It shows us what day to day life would be in the lab, and how to plan our experiments how to troubleshoot them; gives us a bit of exposure to the disappointments you can get and the rewards” (Lab student)

“In fact, I want to have a career in bioscience anyway”

“I found my lit project interesting but I still don’t know what lab work is like”

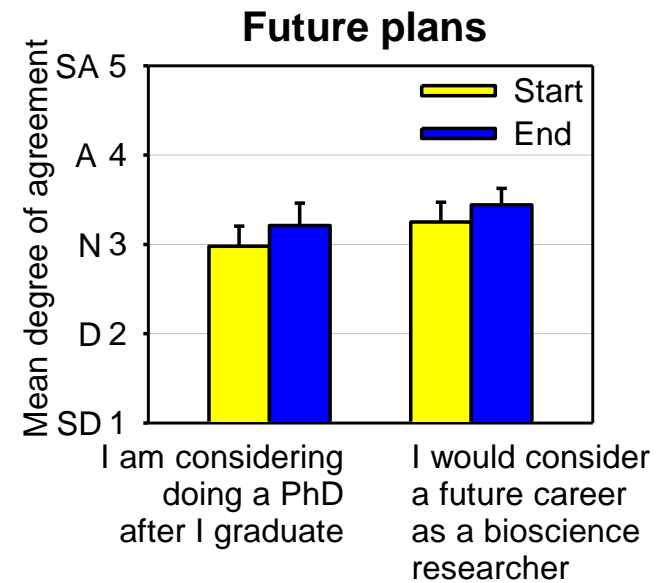
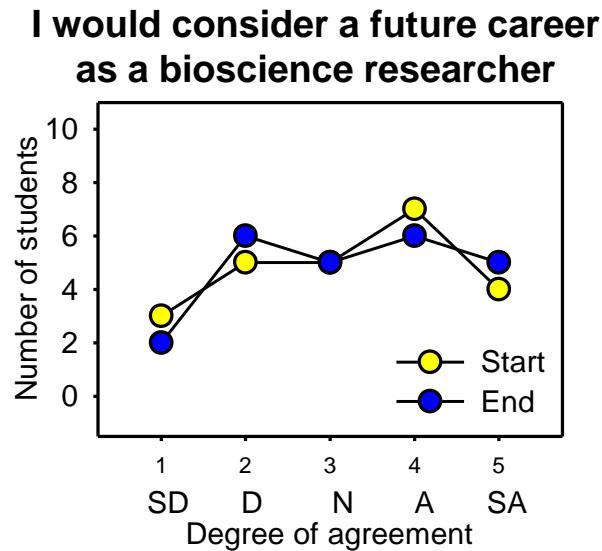
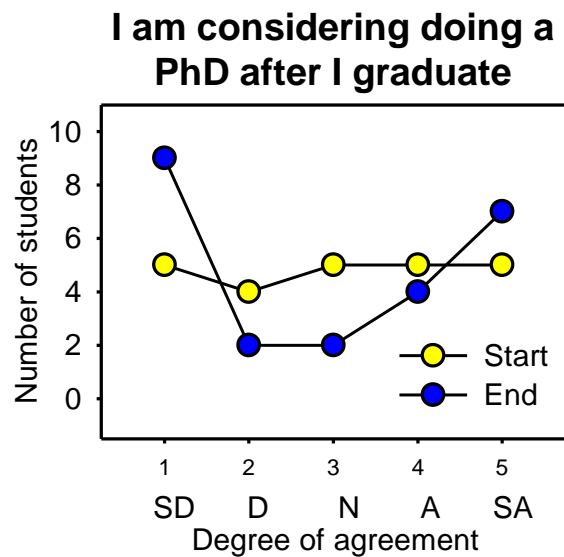
“It shows the good but also the bad sides of it”

Bioscience perceptions & future plans



- Students agree that bioscience research is interesting & exciting, and the mean & distribution are the same at both time points.

However This doesn't mean they want to be bioscientists!.....



- There is a **polarisation** in student views on considering a PhD at the end of the 3rd year, although mean is unchanged.
- Most students either **strongly agree** or **strongly disagree** that they are considering doing a PhD by the end of the 3rd year.
- Of 24 students completing both Q, 12 were unchanged, 6 shifted up and 6 shifted down!

Prompt: What has influenced you to consider/not consider doing a PhD? Representative answers:

[Doing PhD] “My final-year project. Working with a team of people was fun and rewarding, especially when I discovered something new!”

[Not doing PhD] “I’ve always wanted to go into the city. Way before I started at Imperial.”

[Not doing PhD] “Not having enjoyed practicals much, a rather unfriendly atmosphere with few people interested in helping.”

“The experience of being in a lab during the first 2 years has not made me want to be in one for whole days and months on end”

“Put off by lab practicals” was the reason given by 25% of respondents leaving comments.

Work experience can put people off as well as inspire them!

“I realised that working in a lab is probably not for me and I will try to pursue another career path.”

Final reflection – Recipes or Revelation?

Students' perceptions of bioscience research are influenced by their experiences in laboratories.

Do we give them recipes, or reveal what real research is like?

Does it matter? Half our students go on to jobs in the City, Law, Journalism, Circus, etc

Acknowledgements

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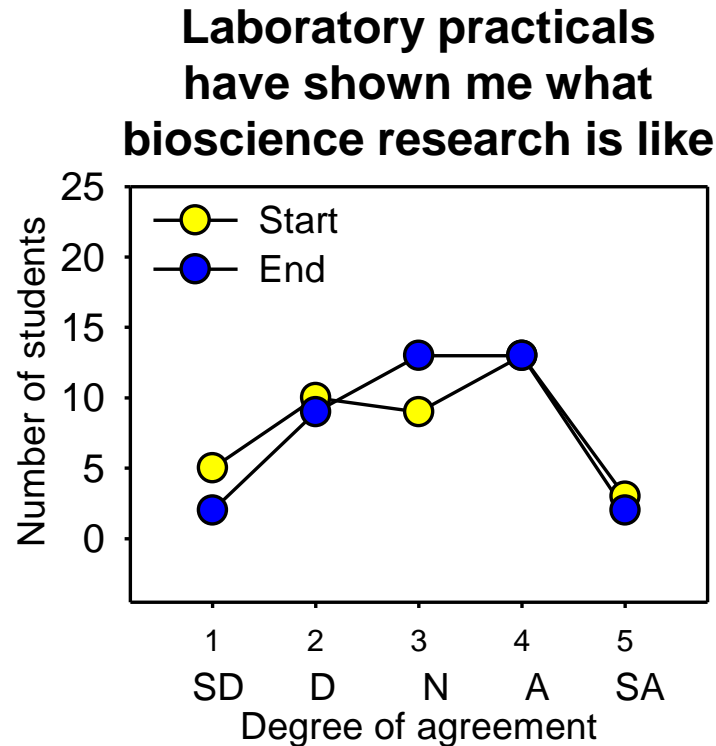
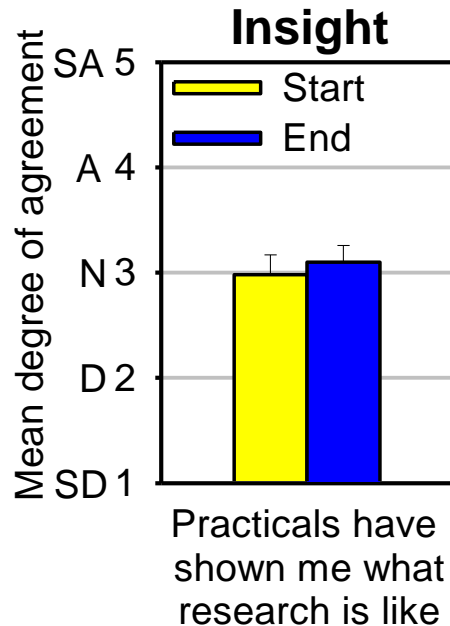
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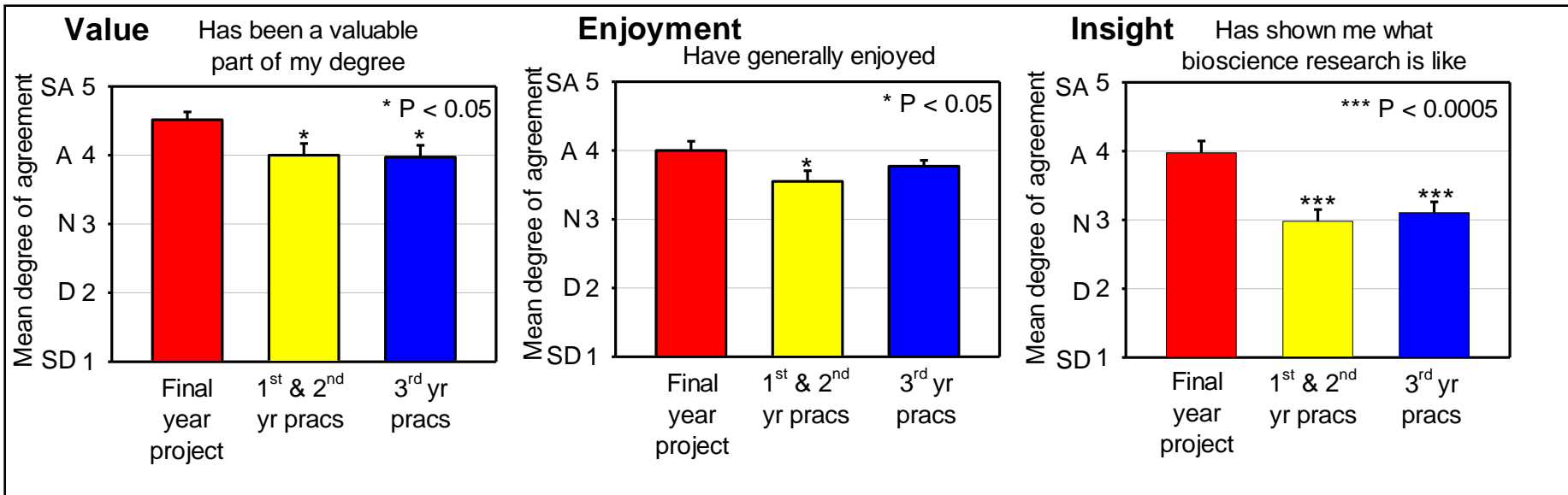


Insight

Ambivalence about practicals showing what research is like – neutral.

No difference between 1st/2nd-year and 3rd-year.





Results Summary

General **agreement** that FYP was **enjoyable**, the **quality** of supervision and feedback was good, and that it had given **insight** into what bioscience research is like.

Students **neutral** about feeling **included** in the bioscience community and the **effect** of the FYP on their consideration of a bioscience career.

Significant difference between lab and lit students for **inclusion**, **insight** into bioscience research and **effect** on bioscience career consideration, with lab students agreeing and lit students disagreeing.