Shifts in student attitudes in IPLS Labs

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Settings

- Algebra-based Introductory Physics for the Life Sciences (IPLS) lab course
- Course have been reformed since 2017 based on NEXUS [1] lab curriculum
- 80% of enrolled students in pre-health majors, 70% plan to attend medical school
- 48% women, 43% men, 2% transgender, 2% non-binary, 5% prefer not to say
- 58% white, 14.5% Hispanic or Latinx, 13% Asian, 4% Black or African American, 4% two or more races, 4% prefer not to say, and 1.6% Native Hawaiian or Pacific Islander (overall slightly more diverse than the U of U undergraduate population)
- 9 lab sections of 24 students with 1 Teaching Assistant and 1 Learning Assistant

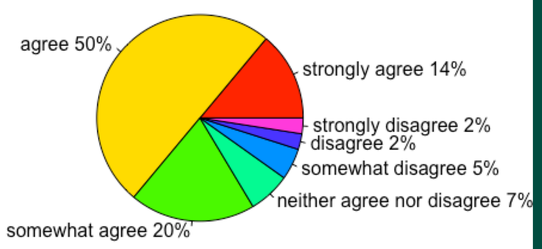
See Jason May's Poster AI08 for an overview of details of our Lab curriculum

Results here presented: End-Semester Survey responses Spring 2019, 122 students consented to research study (71% of total)

Students worked in **three different groups** of 3-4 students each:
- 1st round of groups created based on mixing student by major
- 2nd round of groups designed with help of TAs and LAs to maximize everyone meeting new people
- 3rd round of groups self-selected by students

Learning from/in the process

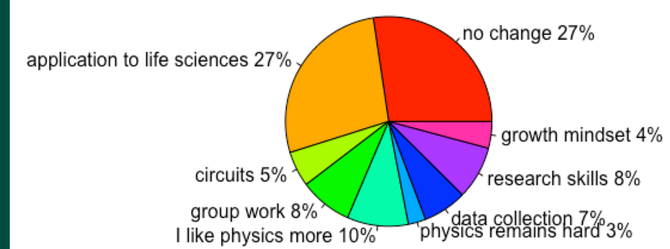
In this lab course, we have emphasized the importance of learning from/in the process, independently from simply getting a final answer. To which extent you agree you have now acquired a more process-oriented learning attitude?



No significant diff. based on gender Fisher's exact test (95% CI = .21, 5.56; p = 1) or race Fisher's exact test (95% CI = .50, Inf; p = 0.19)

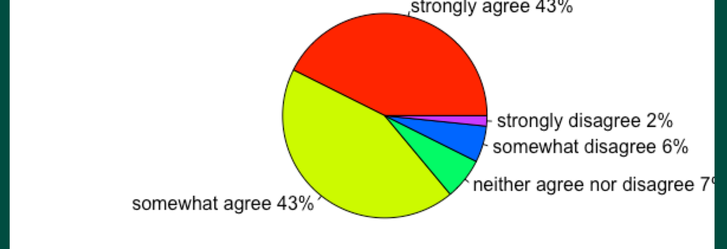
Change of previous preconceptions

Has this lab course **changed some of your previous preconceptions?** Think about this broadly: it could be about a specific concept or knowledge, or about an instrument, or more generally about scientific work, physics, etc.



Switching groups

Please choose to what degree you agree or disagree with the following statement: "Despite challenges that may arise from changing to a new group, I understand how switching groups is beneficial for everyone's learning experience."



No significant difference based on gender Fisher's exact test (95% CI = .15, 4.94; p = 1) or race Fisher's exact test (95% CI = .09, 3.37; p = 0.39).

Follow-up open responses to the question "Please elaborate your thoughts in regards to the previous question" **were analyzed using a grounded like approach** [2]: students' comments were divided based on **recurring themes**, which appear with comparable frequencies.

Enjoying freedom of open answers

"I feel like I have started to gain a better understanding that experiments in lab don't always work out and yet despite that, there are still plenty of concepts we are able to learn despite not always obtaining an answer."

"There were a few times we either had no idea what results we would get, and kind of just did things as they came along. I found that this was just as effective as having a foolproof hypothesis, as it was more of a journey."

Learning through explaining

"This course has helped me realize the importance of learning from the process based on how the experiments were set up in different parts. Also the TA checks were instrumental in this because you had to explain to the TA the concepts before moving on to the next section."

"The TA and LA made it a point to not just give you answers to specific questions. Instead they would ask me questions so that I would lead myself to a new answer or process. Very helpful."

More relaxed atmosphere b/c not grading for final answer

"Given the more relaxed environment compared to some other labs, this let me focus on how to do something rather than just getting the end result to a grade."

"I think that this was very apparent in the lab and that's what made it more enjoyable in that the TAs weren't focused on the final answer."

Working hard makes you learn better

"It took a lot to get to the final answer and we had to work a lot as a team to get to the answer and that is where all the learning took place."

"The TA and LA never told us the straight answer and made us work for it which I enjoyed. It made the topic stick better and helped me actually learn how to go about whatever we had a question with."

Frustration

"I find lab very frustrating. It is one thing to struggle to get to the answer, but this lab gives almost no hints and you never know if you're even close to the answer and have to start over."

Application to life sciences (27%)

"The nature of the course exposed me to a greater sense of and appreciation for the overlap of physics and biology as I had previously never really considered or realized how big a role physics plays in biology, physiology, anatomy, etc. Having studied Kinesiology, I was able to appreciate things like Biomechanics, but the molecular physics within biology was really eye opening"

Value of group work (8%)

"I have generally thought that lab work would be best done silently and alone, as it has been the most efficient for me in the past. However, this lab has helped me trust my teammates work and be able to depend on others to get something done together more efficiently."

Knowledge of data collection (7%)

Growth mindset/patience/hard work (4%)

This lab has changed my idea about my scientific process. I felt more okay with making mistakes as long as I could explain and understand what happened. Before I believed that if an error was made and recognized the whole process had to be scrapped and redone. Actually making errors has been an important part of my growth in this course

Physics remains hard (3%)

No change (27%)

I like physics more (10%)

"I actually didn't like physics much prior to this lab. After this lab, I do enjoy physics more. I have been able to see how it is applicable to my future career."

Research skills (8%)

conducting experiments/reading papers/presentations

Understanding circuits better (5%)

Yes, my previous perceptions of currents were changed. Actually seeing it applied to biology was much easier to understand and in grasping the concept.

Note on statistics results: We have run Fisher's exact test to compare responses between: female and male students, URM and non-URM students. We have defined underrepresented minorities (URM) to include any of the following: Black, Hispanic, Latinx, Pacific Islander, Native, Mixed, and non-URM as: White, Asian, White/Asian. We acknowledge that grouping White and Asian students together neglects important differences in these groups' experiences. We adopt this approach here to focus on the experience of URM students in comparison to others.

Gender and Race: we have found **no statistically significant difference** in any of the results here presented based on gender or race.

Important if you are in a unproductive group

{..] Last semester, I had a pretty bad group and we never had a group change so I do still think a group change might be beneficial for unbalanced groups.

It teaches you to be flexible

"I understand that changing groups allows for everyone to adapt to new roles and responsibilities within the groups and that way, it's not just the same person doing all of the work every week."

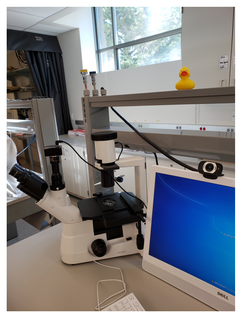
"I understand the importance of switching groups and I did learn from it. One group was really easy to work with and everyone worked efficiently. The other group needed more guidance and direction, which was less pleasant to work with, but I did learn to adapt and that was beneficial."

Wonderful to meet new people

Meeting new people was wonderful. I support switching groups.

It takes work and time to build new connections

I didn't like switching groups. I made it hard to focus on content because you were constantly having to create new social connections



Our lab is located in the novel Crocker Science Center at University of Utah. We acknowledge the support of the College of Science and the technical help of David Robert Thomas.

References

[1] E. F. Redish, et al., *Am. J. Phys.* **82**, 368 (2014).*NEXUS: National experiment in undergraduate science education*, https://www.hhmi.org/ developing-scientists/nexus.
K. Moore, J. Giannini, and W. Losert, *Am. J. Phys.* **82**, 387 (2014).

[2] Strauss, A., & Juliet, C. (1994). Grounded Theory Methodology: An Overview. In N. Denzin & Y. Lincoln Handbook of Qualitative Research. 1st ed.

Ask us about the Duck for Help!