Analyzing the Effectiveness of Remote Laboratories

Patrick Macaulay
Zachary Newlon
Erika Wentz
Peter Zollinger

The COVID-19 pandemic has changed all forms of education, including labs

Online labs: How has the transition affected student learning and faculty's teaching?

- **Students**
  - Gather student perceptions
- **Faculty**
  - Understand challenges faced by faculty
- **Analysis**
  - Analyze effectiveness of remote laboratories

Lab Courses Surveyed

Chemistry
- CH 1020

Physics
- PH 1120
- PH 1140

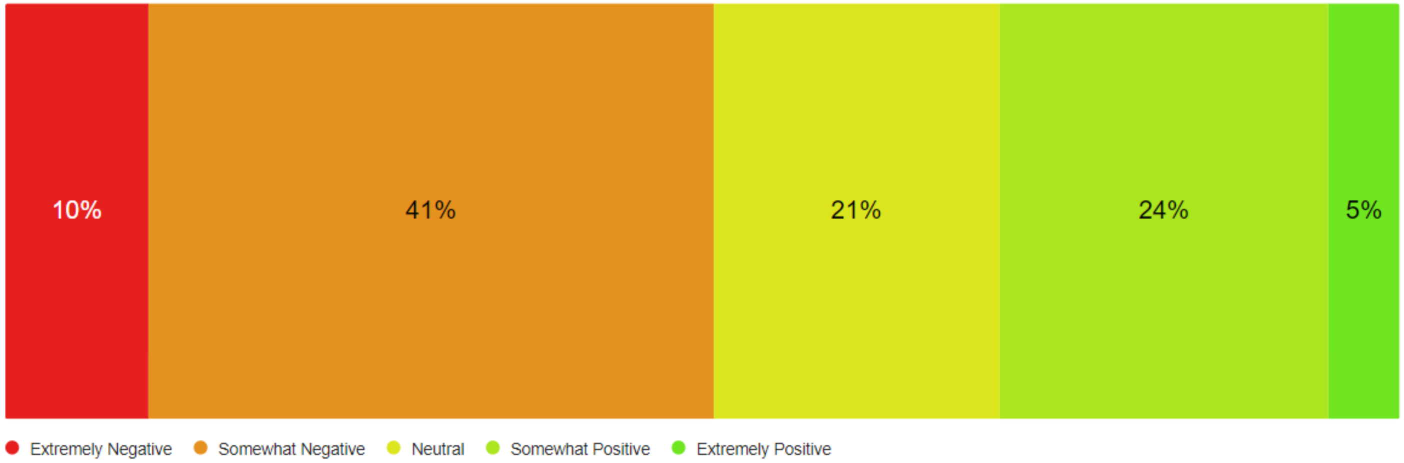
Engineering
- ME 1800
- ECE 2010
- BME 3111
- ME 3902

Students have a negative opinion of remote learning

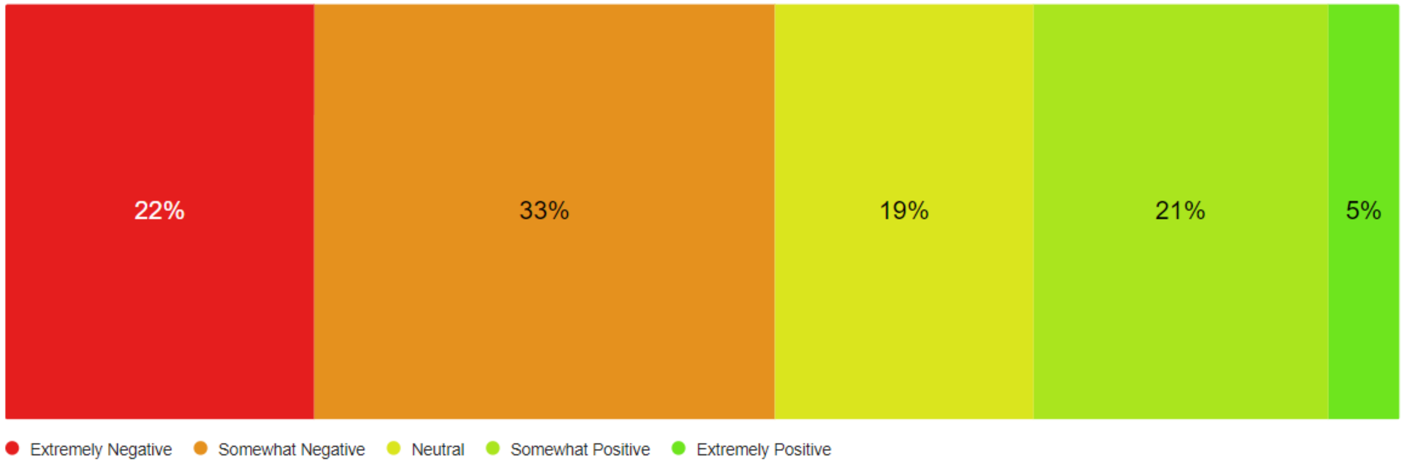
n = 195

Students have stronger negative opinions of labs

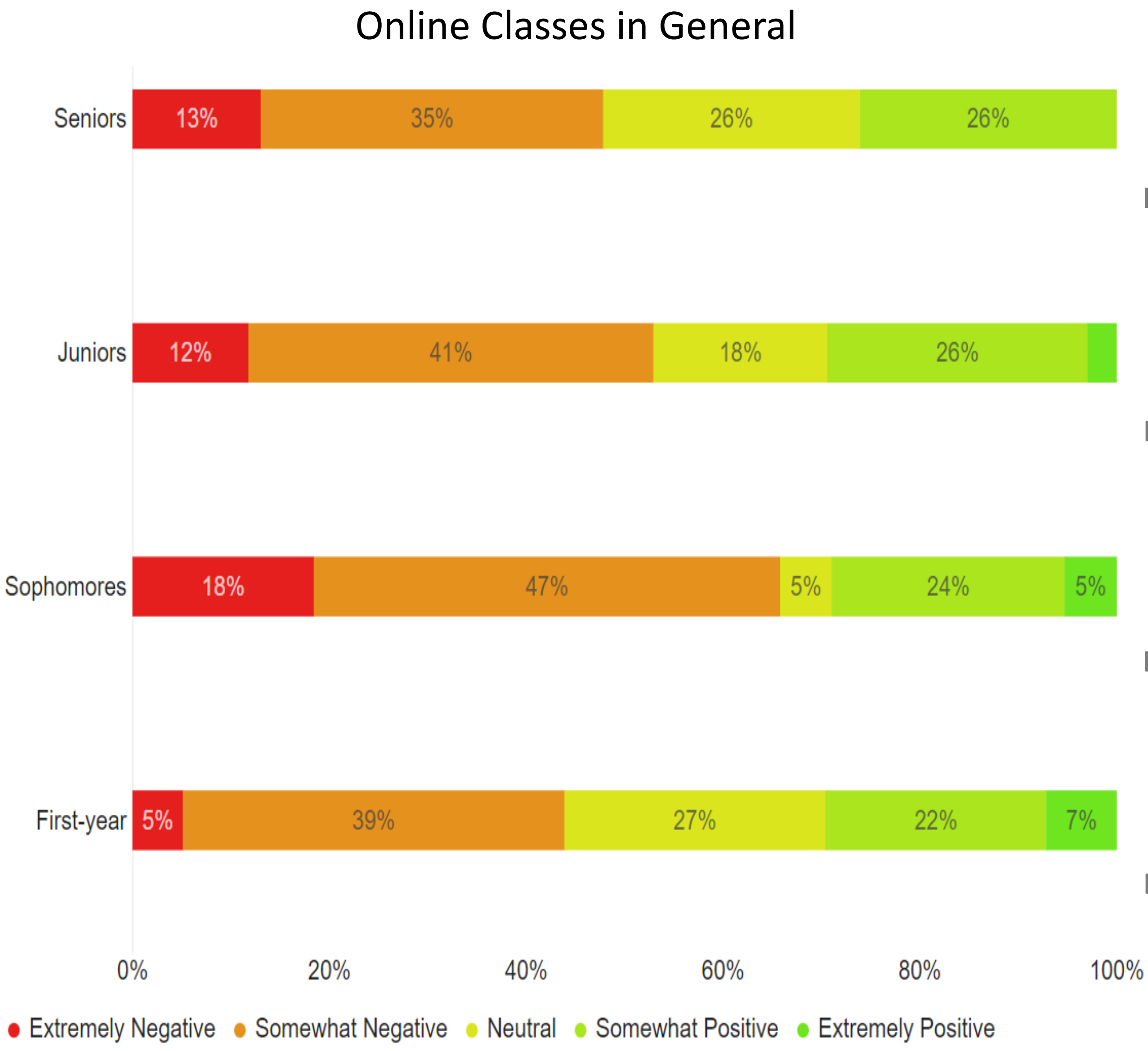
How would you describe your opinion of the transition to remote learning in general?

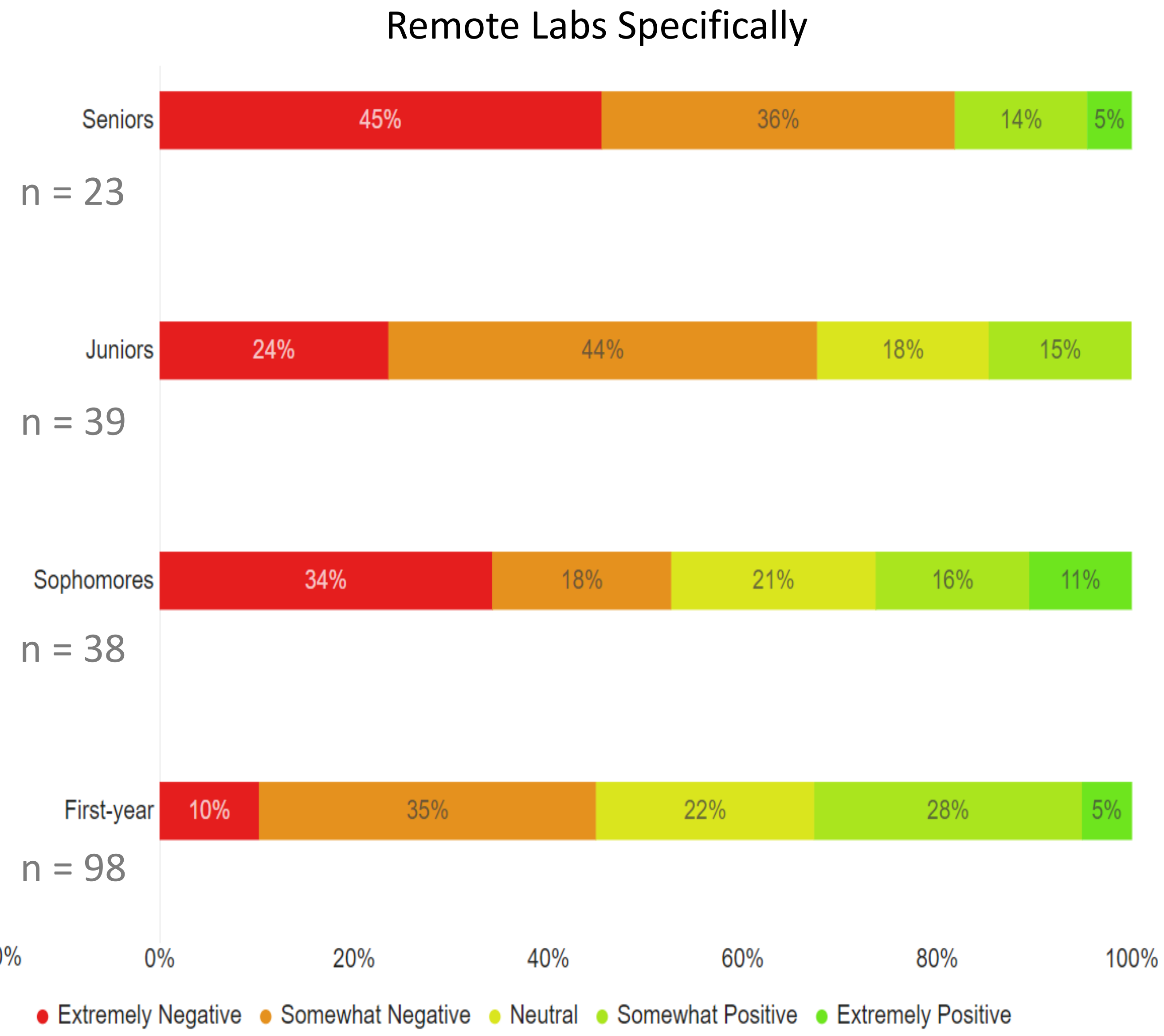


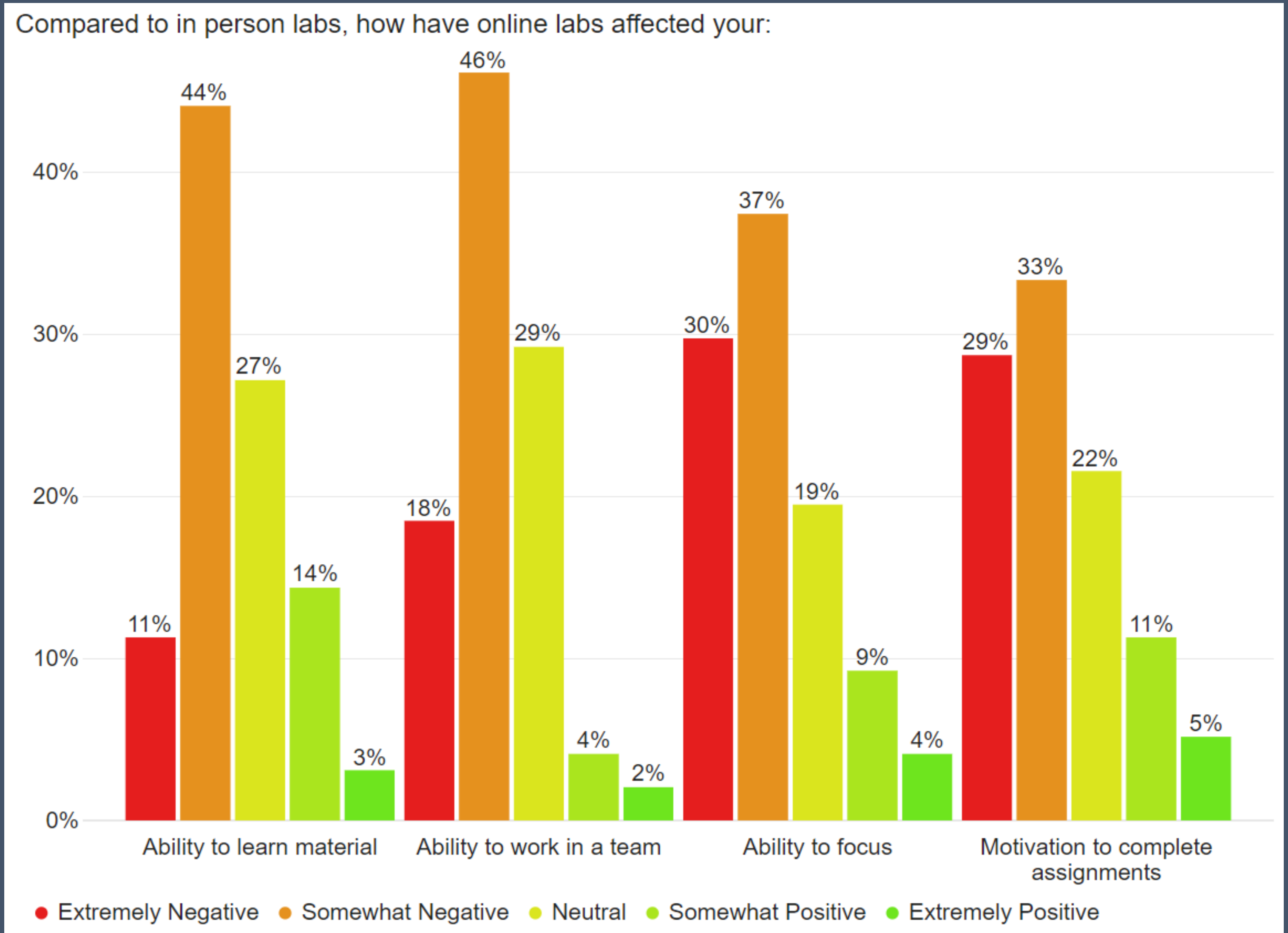
How would you describe your opinion of the transition to remote lab experiences, specifically?



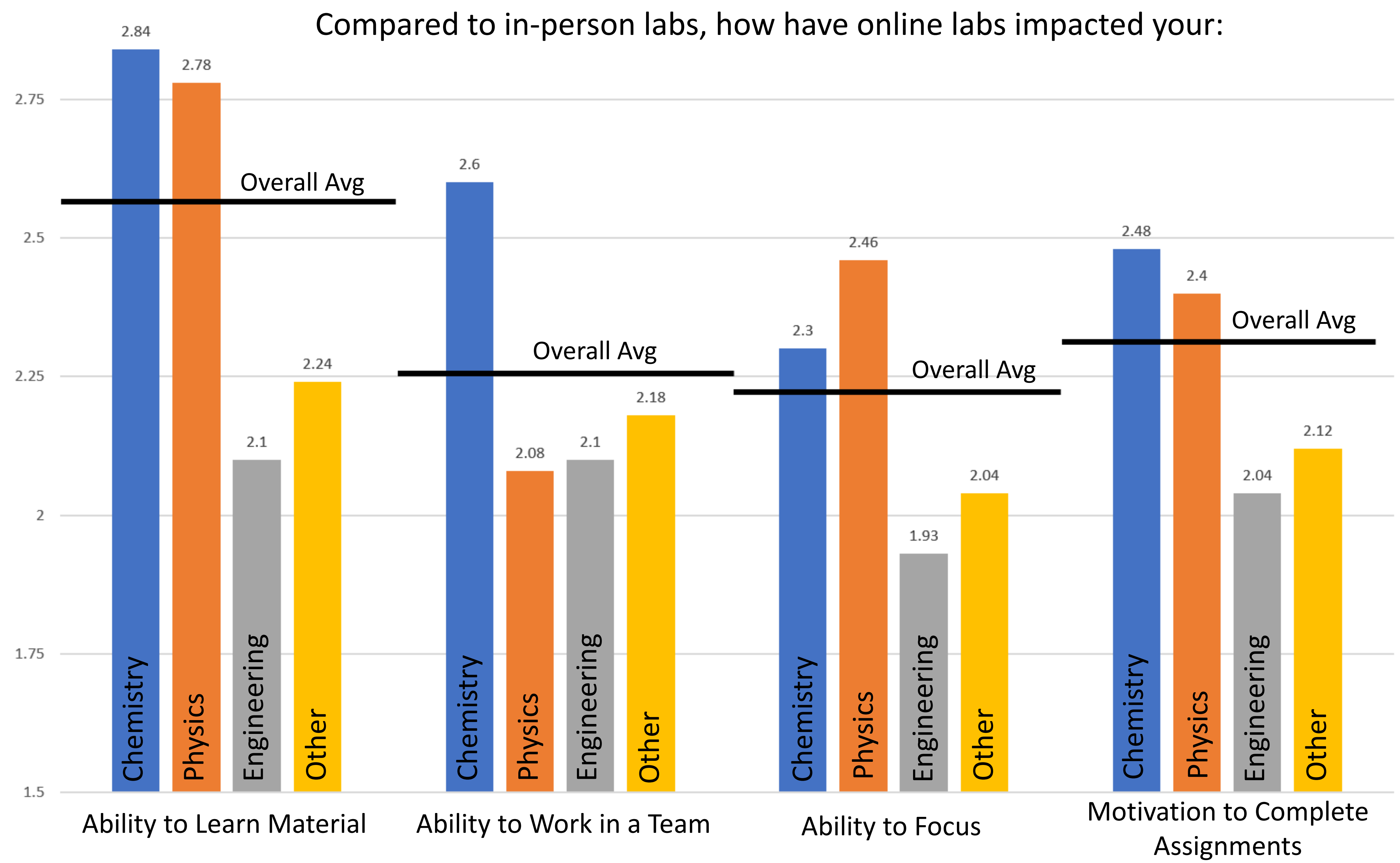
Student Experience by Year







Students struggle in online environments


Compared to in-person labs, how have online labs impacted your:
2.84
2.78
2.75
Overall Avg
2.6
2.5
2.46
2.48
2.4
Overall Avg
2.3
Overall Avg
Overall Avg
2.25
2.24
2.18
2.12
2.1
2.08
2.1
2.04
2.04
2
1.93
1.75
1.5
Chemistry
Physics
Engineering
Other
Chemistry
Physics
Engineering
Other
Chemistry
Physics
Engineering
Other
Chemistry
Physics
Engineering
Other
Ability to Learn Material
Ability to Work in a Team
Ability to Focus
Motivation to Complete Assignments

Student Takeaways

More time to develop understanding of concepts

Procedures are more clear

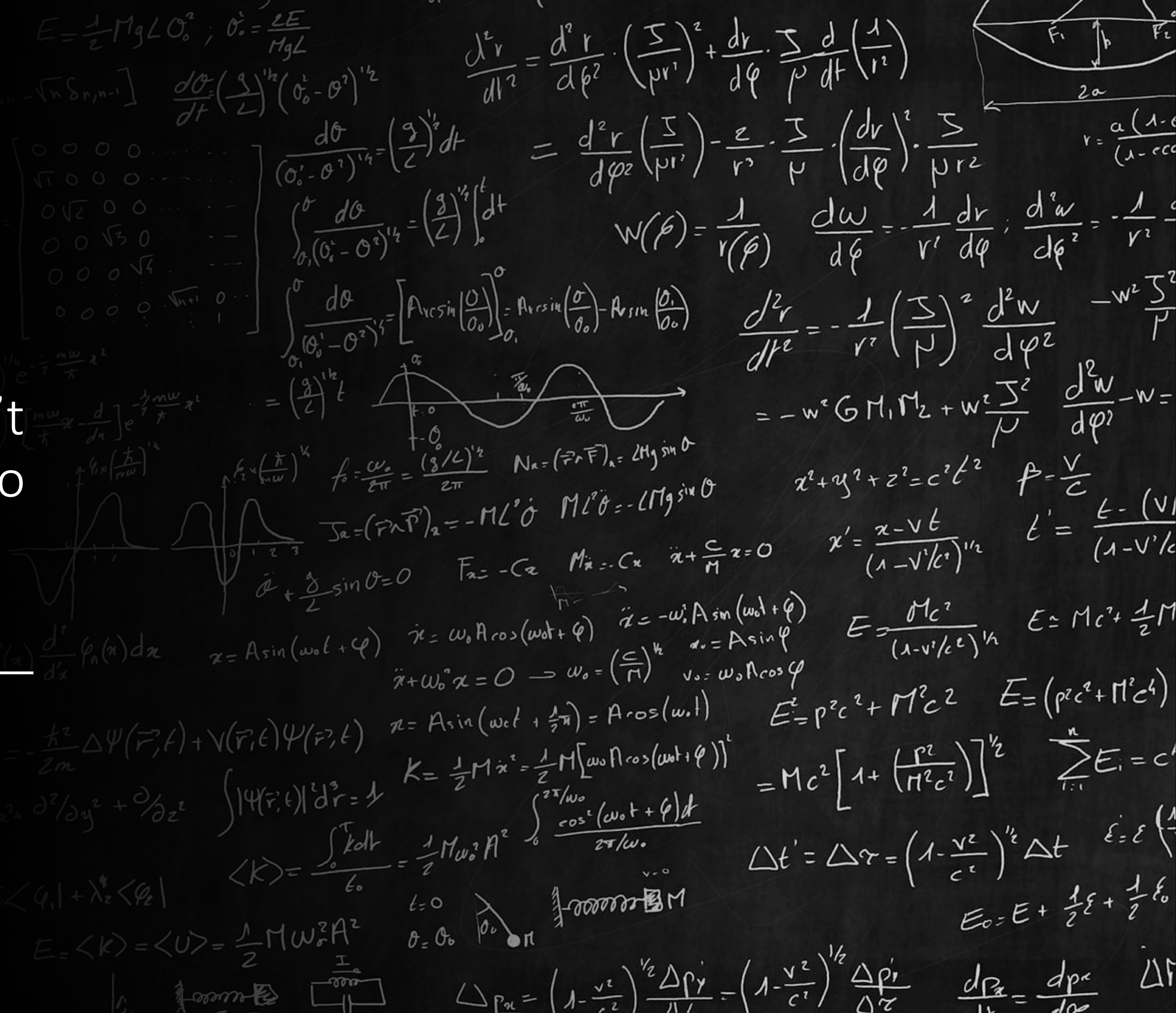
Online simulations allowed labs to still have an in-person feel

No in-person help

Labs take more time

Difficult to communicate

Difficult to stay on top of assignments



"I think that the online labs get the job done...but they just can't compare to being able to physically interact with materials"

Student Biomedical Engineering '23

Physics lab

Instructor Takeaways

+	−
More time to review concepts	Lacking in-person connection
Higher quality lab reports	Difficult to communicate
Online simulations are safe for students and equipment	Missing experimental process

David Mavor

Chemistry Professor

“This is extremely stressful for absolutely everyone [and I am] trying to be accommodating to all of that.”

Rudra Kafle

Physics Professor

Week 4 of online classes

"When the students are in my studio class, after one or two weeks, I know names of all my 72 students in the class...I know only maybe five or ten names by today."

Final Conclusions

- Students are dissatisfied but doing their best
  - Missing experimental process
- Professors are missing connections with students
  - Communication is more difficult
- Higher level engineering classes are struggling the most
  - For a phased reopening of campus, higher level laboratory courses could benefit from being a priority

Acknowledgments

Thank you to all the instructors who worked with us to get the survey out to students.

Special thank you to those professors who took the time out of their days to speak with us about their experiences.

Thank you to our advisors, Peter Hansen and Bruce Bursten, whose guidance made this project possible.

Thank you

Questions?