

Student Surveys and Mindset Interventions: Analysis from Reformed IPLS Labs

Jason M May¹ and Jordan M Gerton¹, Claudia De Grandi¹, Lauren Barth-Cohen^{1,2}, Brianna Montoya³
¹Department of Physics & Astronomy, University of Utah; ²Department of Educational Psychology, University of Utah; ³Department of Physics, University of Maryland, College Park

Project 1: Implementation of FLAMENet Research Reflection Interventions

Failure as a part of Learning: A Mindset Education network (FLAMENet)¹ is a national network designed to create educational interventions to bolster student resiliency and persistence in STEM.

Our research and instructional teams implemented **Research Reflections**¹ in our Spring 2019 first-semester reformed IPLS lab course (N=61). The Research Reflections prompt students to consider upcoming challenges in research-oriented tasks of the class, reflect on these tasks after completed, and also reflect on their mindset towards failure and resiliency in light of these challenges (see Figure 1 for Research Reflection format).

Example interventions and student responses are shown below. Questions 1, 2, and 3 are post-lab reflective question given to students after completing the first lab of the semester. Respective word clouds² represent student responses; word size corresponds to word frequency in all student responses. Question 4 was given to students at the end of the semester, prompting students to reflect on their growth amid obstacles in research-oriented tasks. A selected student quote is also given for each question.

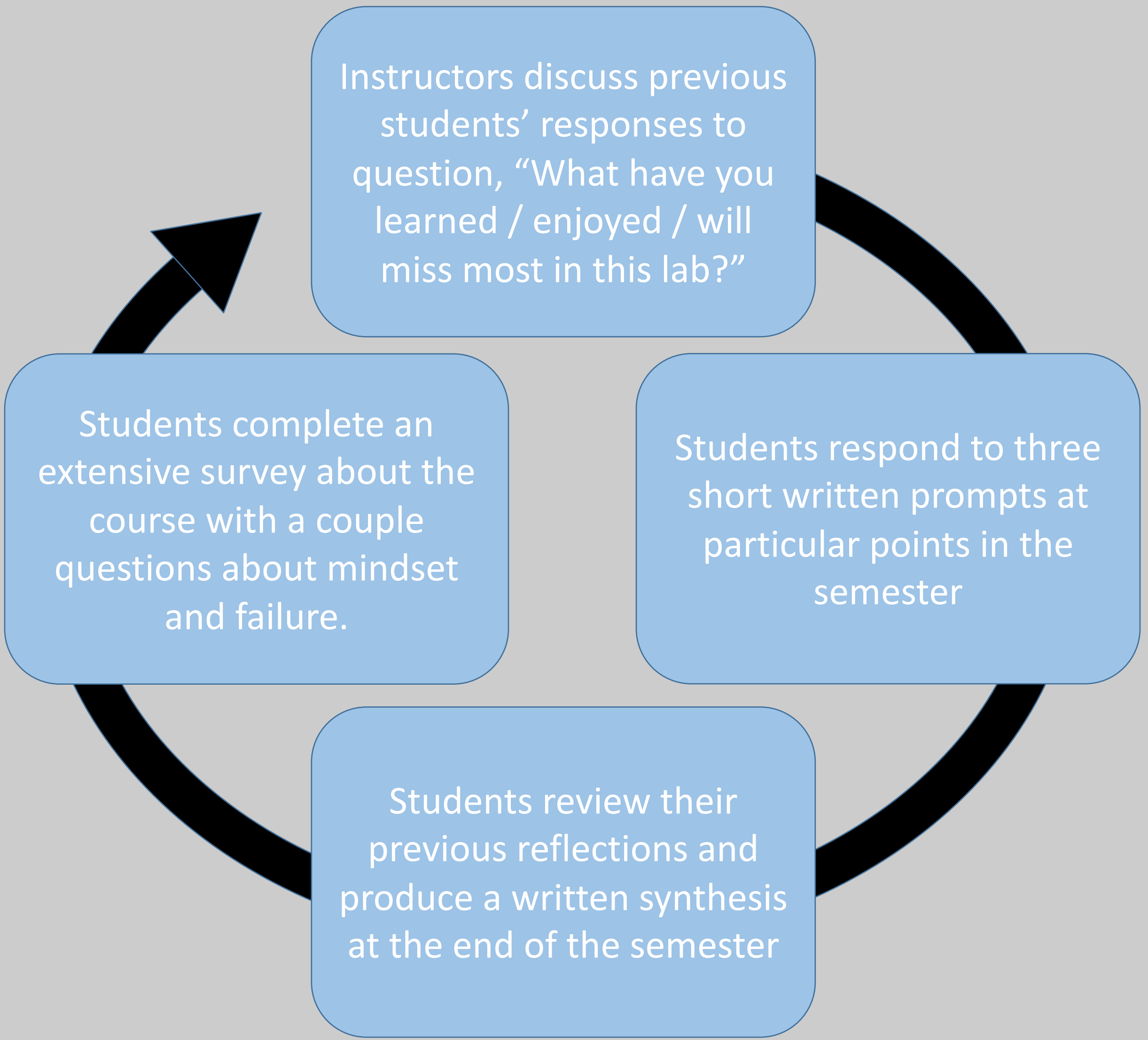



Figure 1²: FLAMENet Research Reflection Format

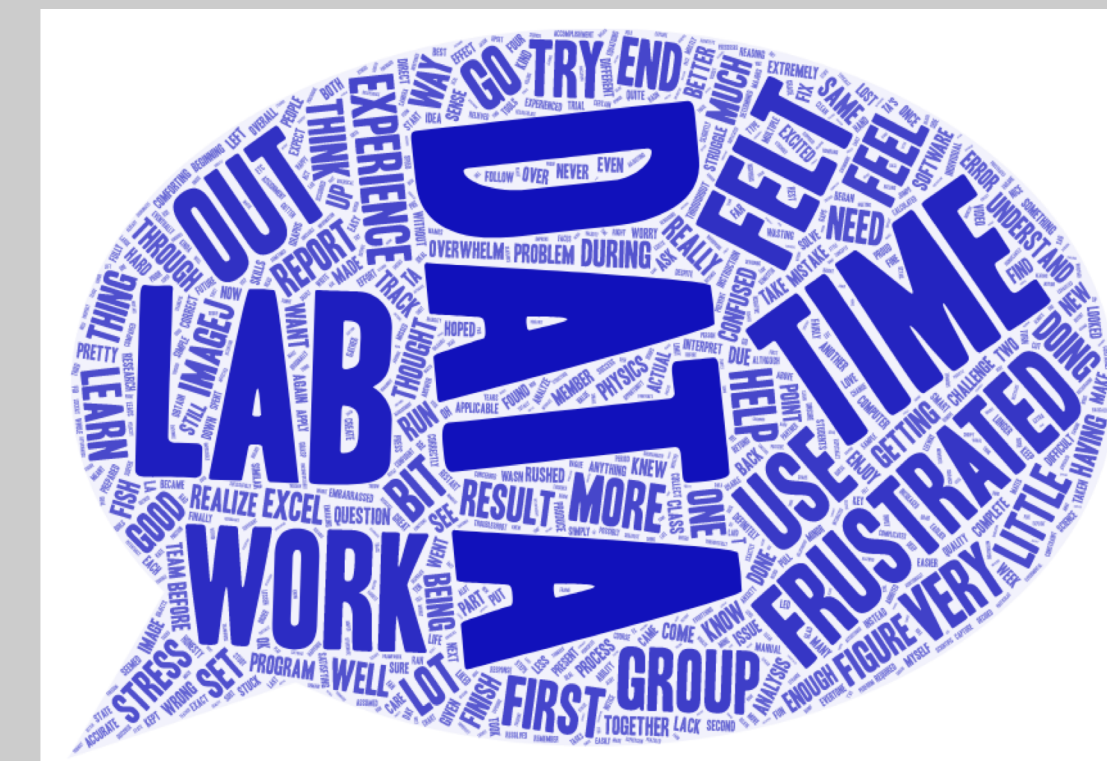
Question 1



Please describe research-related challenges, failures and/or unanticipated results that you encountered during Lab 1.

"When we first did the experiment we didn't know how to collect data or how to do a plan for the experiment. We didn't plan really well [well] to design the experiment."


Question 2



Describe the thoughts and feelings you experienced in response to these challenges.

"It was a little frustrated and helpful to learn from our mistakes."

Question 3



Please describe actions you took after encountering the challenge. Were these actions helpful or unhelpful? Why?

"We as a group started to encourage each other and say it's okay we can do a better plan next time."

Question 4

Describe your behavior, attitudes, and/or coping strategies in response to anticipated or unanticipated obstacles in this class.

"At the begning [beginning] I was afraid to fail or to do something incorrectly..., I feel embarrassed to ask for help. When I saw how supported my team is I got more comfortable asking them questions. In my oponion [opinion] the most trait was the most imprtant [important] to succeed in class is to get out of my comfort zone and get involved in group discussion. It was one of the labs that I felt like I'm in control and this is my expermint [experiment] not like a cooking book following the ingredient [ingredient]. I feel like this is my own expermint [experiment] and I'm doing it for my own research not for class."

Project 2: E-CLASS Survey Implementation

E-CLASS Survey Overview:

- Colorado Learning Attitudes about Science Survey for Experimental Physics³, nationally validated and widely utilized physics attitudes survey
- Pre- and post-course survey administered to Spring 2019 mechanics-based reformed IPLS lab course (our courses, N=52; similar courses, N=8102)

Analysis of Student Responses:

- Preliminary analysis of student responses suggests that there is no statistically significant difference between our course's pre-post changes in overall perceptions and attitudes of physics when compared to national data of students in other similar-level courses⁴ (see Figure 3).
- Preliminary analysis of student responses suggests that there is a statistically significant difference between our students' changes in interest of physics when compared to national data of students in other similar-level courses⁴ (see Figure 4).

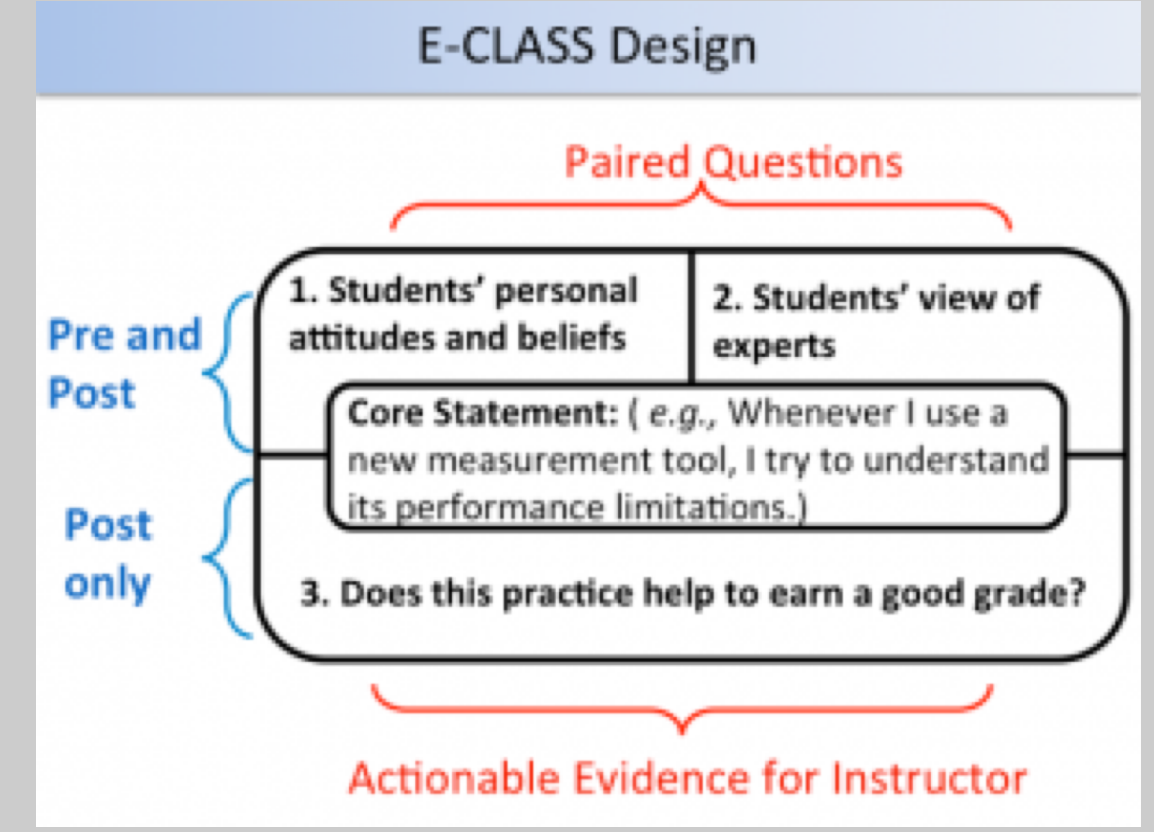


Figure 2⁴ – E-CLASS Design showing question types in pre-and post-course surveys.

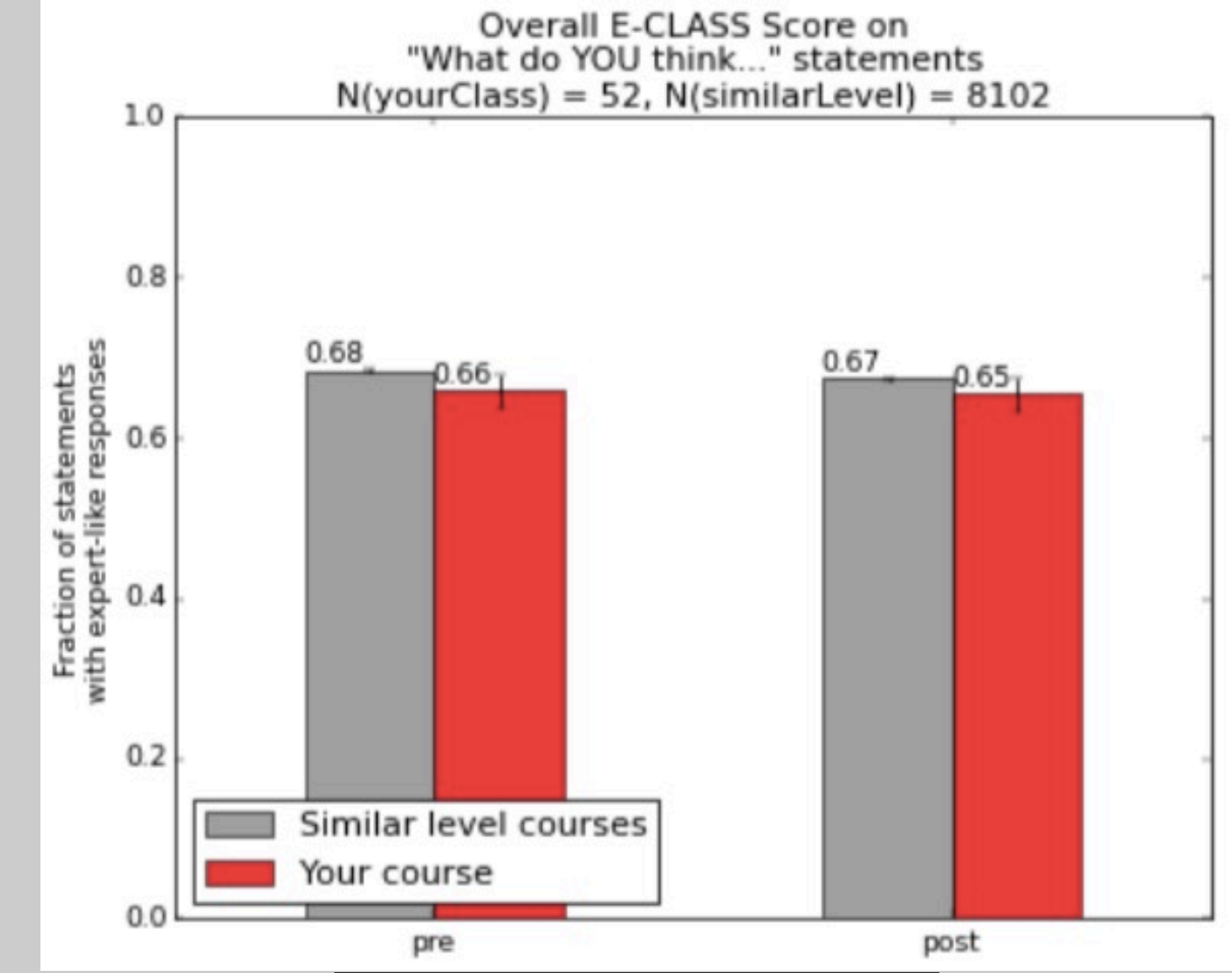


Figure 3 – Overall E-CLASS Scores (p=0.5528)

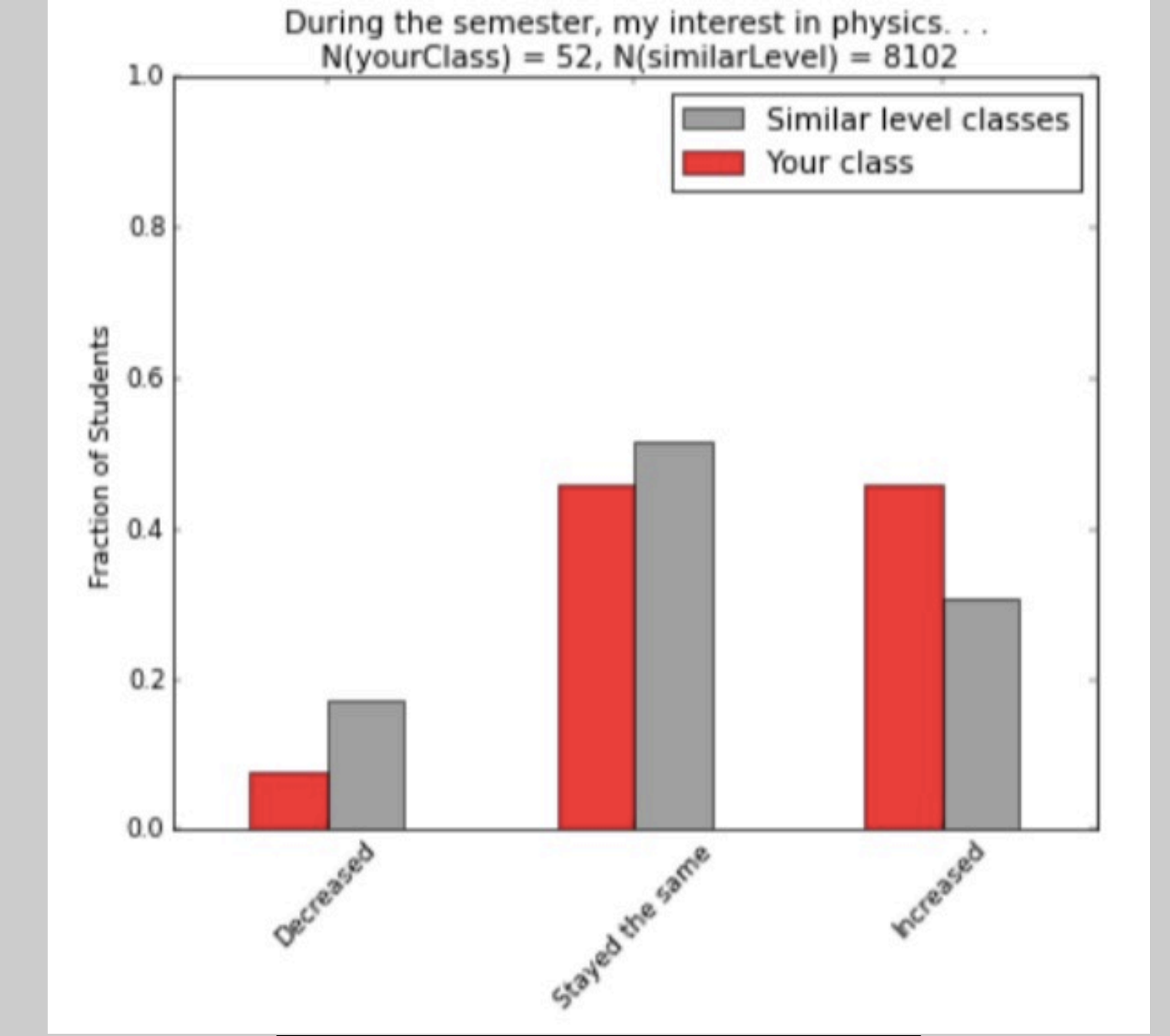


Figure 4 – Pre-Post Interest in Physics (p=0.0483)

Joint Project Discussion

Reform Impacts on Students' Perception of Physics

- Results suggest that students in our reformed IPLS labs:
 - Show greater interest in physics than those in similar-level courses (see Figure 4)
 - May experience pre-post changes in their attitudes and perceptions of physics comparable to those in other reformed introductory physics labs (further analysis ongoing, see Figure 2)
 - May experience more positive changes in their attitudes and perceptions of physics than students in traditional introductory physics labs (further analysis ongoing, see Figure 2)
- Future Work:
 - Study possible correlation of results with other variables (gender, race, prior content knowledge, etc.)

Reform Impacts on Student Resiliency and Persistence in STEM:

- Results suggest that students in our reformed IPLS labs:
 - Experience a sense of growth in resiliency and persistency in high-stakes research-based academic environments
 - May experience a shift in mindset with regards to failure in STEM.
 - Utilize various methods of support (teaching assistants, group work, self-reflection) to positively respond to failure
- Future Work:
 - Comparison to similar FLAMENet interventions implemented in traditional and reformed courses is needed to show significance of the course reforms.
 - Thematic coding and analysis based on grounded theory coding framework⁵

Acknowledgements

This project was possible through the efforts of Project NEXUS at the University of Maryland and the FLAMENet project. This project was funded by the College of Science and the Department of Physics & Astronomy at the University of Utah.

References

¹Heemstra, J., FLAMENet (2019).
²Gerton, J., 2019 FLAMENet Workshop (2019).
³Zwickl, B. M., Hirokawa, T., Finkelstein, N., & Lewandowski, H. J. *10*(1) (2014).
⁴<https://jila.colorado.edu/lewandowski/research/e-class-colorado-learning-attitudes-about-science-survey-experimental-physics>
⁵Strauss, A., & Juliet, C., Grounded Theory Methodology: An Overview. (1994).
⁶Holmes, N. G., Olsen, J., Thomas, J. L., & Wieman, C. E. *Phys. Rev. Phys. Educ. Res.*, **13**(1) (2017).
⁷Wilcox, B. R., & Lewandowski, H. J. *Phys. Rev. Phys. Educ. Res.*, **13**(1) (2017).



Scan this QR code for access to this poster!