ISLE-Inspired Design Laboratory Transformation at Princeton U.

Year Two Results

Katerina Visnjic

Co-authors: Catherine Riihimaki, Carolyn Sealfon, Evelyn Laffey

July 30, 2015

The Course: General Physics (PHY103/104)

- Calculus-based
- ~300 students
- Prerequisite for majors in
  - Engineering
  - Computer science
- For most, this is their first and last college physics class.
- 1 lecture, 3 “sections”, and 1 lab per week.

Motivation to change:

General dissatisfaction with labs, from students and faculty.

Transformation

Pilot, 1st Year (2013-2014):

- 2 experimental lab sections out of 16 total.
- Visnjic in classroom at all times.
- Main difference: Using ISLE-based labs!! To learn the *process* of science, rather than just the results.

http://paer.rutgers.edu/pt3/introduction.php

Phase II, 2nd Year (2014-2015):

- 8 "new lab" sections out of 16 total.
- Trained TAs teaching the labs.

Full expansion, 3rd Year (2015-2016)

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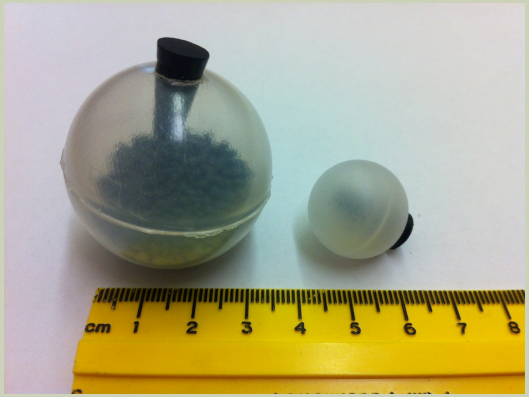
Fluid Resistance (Testing Experiment)

Hypothesis to be tested:

The force exerted by a fluid (air, water) on an object does not depend on the speed of the object.

FALSE!



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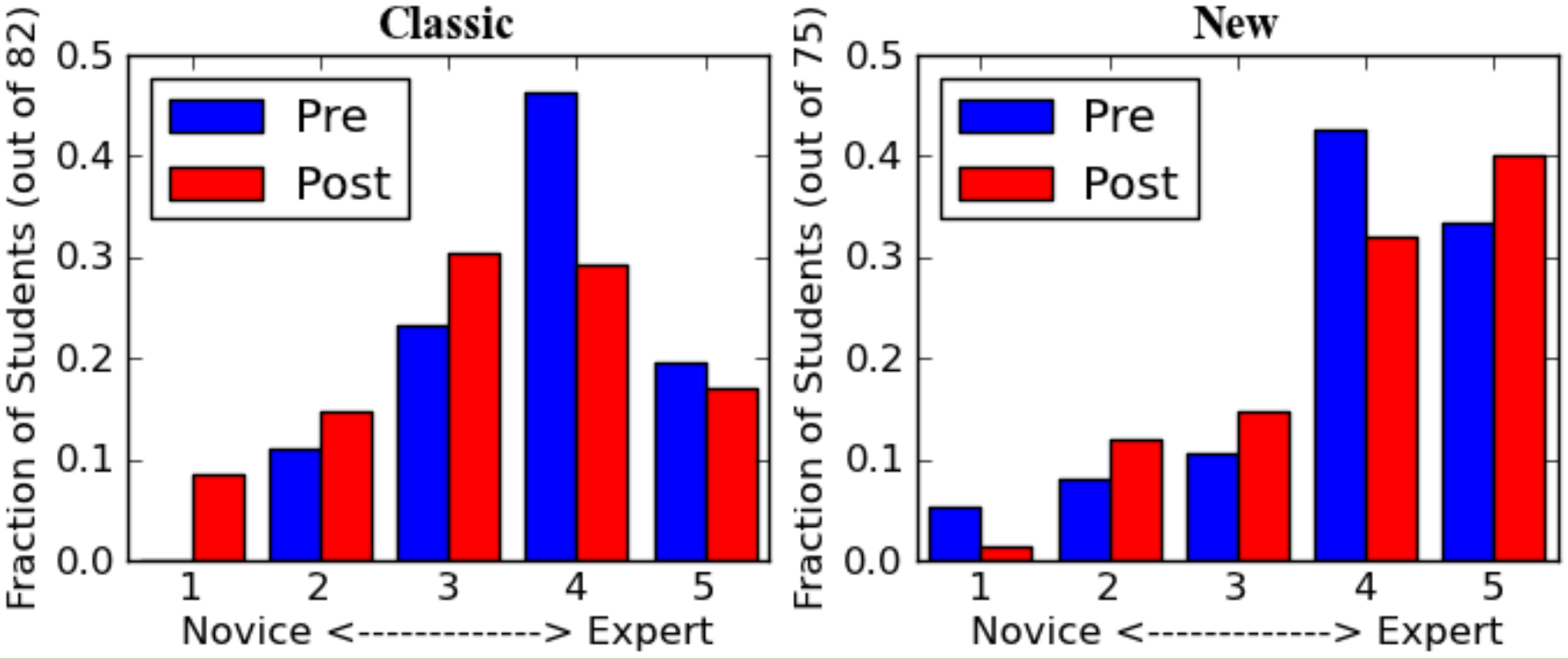
E-CLASS Variant – exact question

Statement: I am usually able to complete an experiment without understanding the equations and physics ideas that describe the system I am investigating.



Common language effect size: 0.66, 3.5σ

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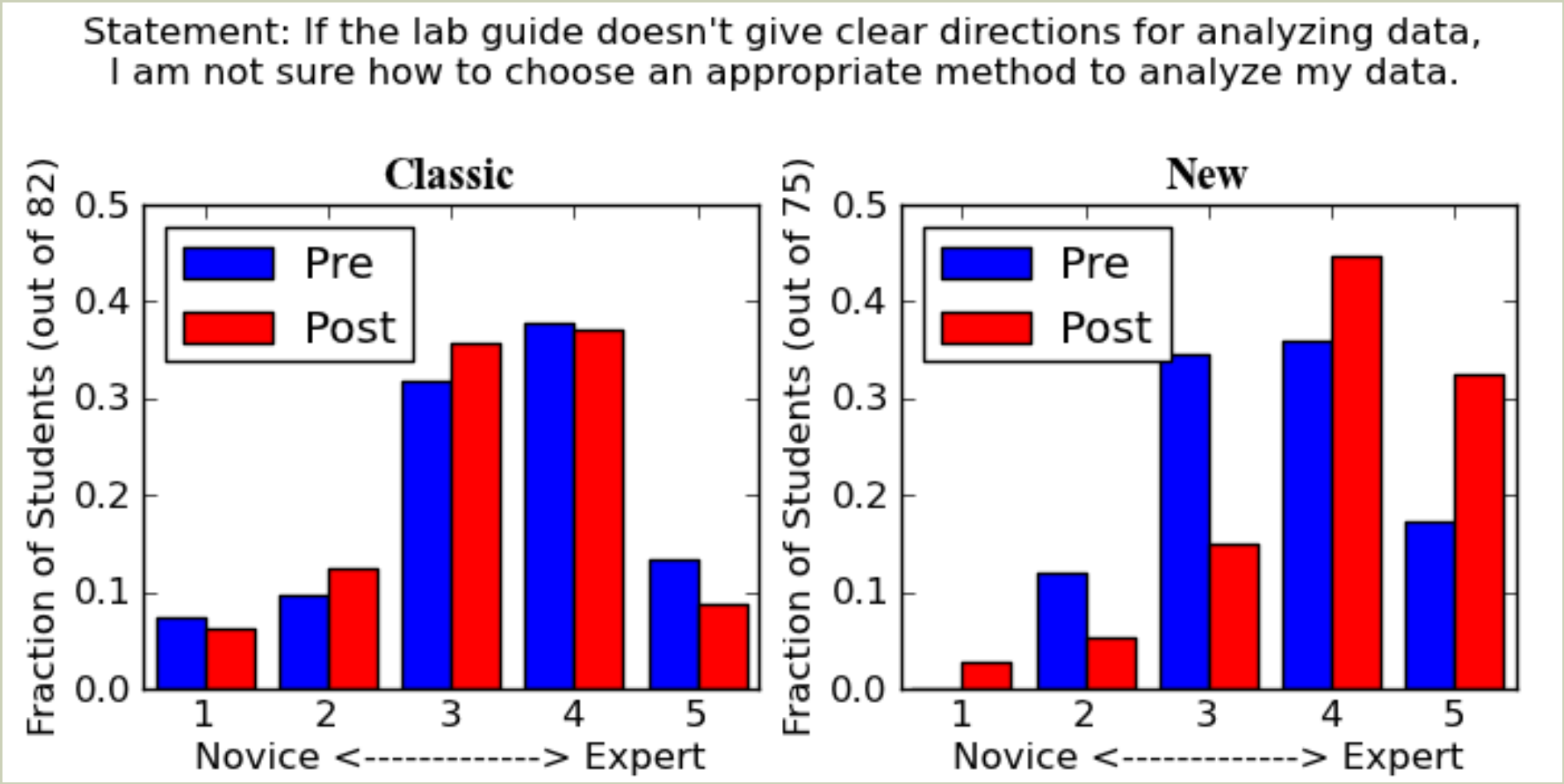
E-CLASS Variant – exact question



Common language effect size: 0.70, 4.4σ

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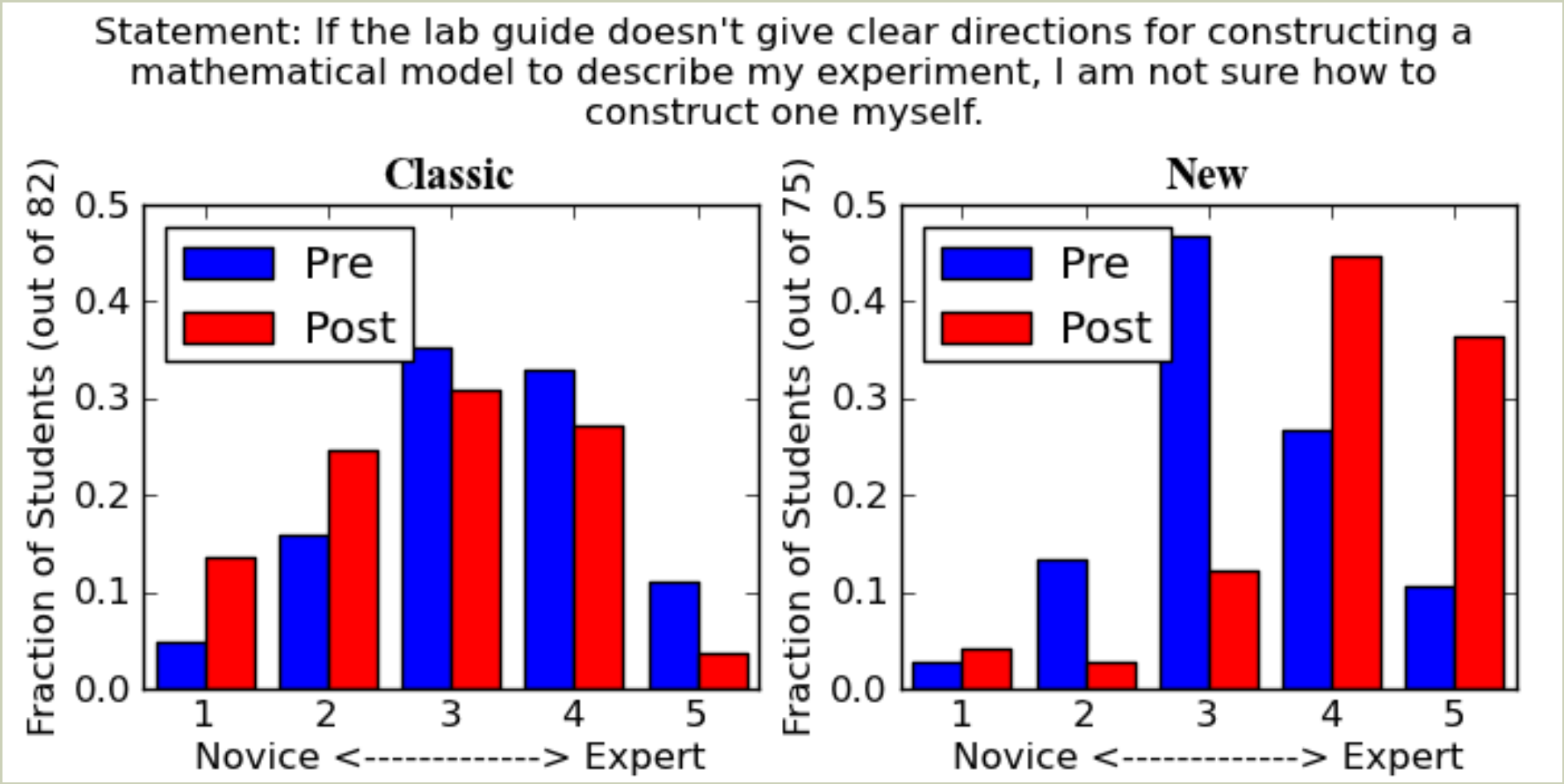
E-CLASS Variant – modified question



Common language effect size: 0.80, 6.6σ

Student Interviews

Number of students interviewed

	Spring 2014	Spring 2015
1st cohort (2013-14)	7	4
2nd cohort (2014-15)	–	4

Emergent Themes

- Students were positive about new labs, reported greater affect as compared with classic labs. Could be intimidating at first, but the challenge was rewarding.
- Felt they gained experience of doing research (even though what they discovered was already known).
- 1 year later, still valued skills like data analysis, and felt confident in solving complex, open-ended problems in other courses/fields.
- Relationship with instructor was very important and correlated highly with affect, but also…
- Certain things were independent of instructor, like learning new skills (data analysis) and problem solving

Improved Affect

"Generally, lab is exhausting but fun, and we get cool toys to play with. "

-Zoe, 1st interview, 2015

"There is a lot of emphasis on real world expectations. We're encouraged to explore why [our result] is not exact and how the assumptions affect the results of our experiments … it is definitely more challenging, and I do agree that it is frustrating sometimes, but at the same time I do know that this is how it is supposed to be, and so this is the right way to do it, and so that makes it OK."

–Sam, 1st interview, 2015

Transfer of Habits of Mind

- It's definitely an idea that I think I take for granted now after PHY103/104, …[before] it almost seemed weird like you're doing something wrong, but then you become comfortable with the idea that it's OK to make these assumptions as long as you acknowledge that they're there … I don't even realize it as much when I do it now, because it's something that became so comfortable last year.

  –Matt, follow-up interview, 2015

Problem Solving Skills

"I know I've done that before, so when I come to another problem where I feel like I have no idea how to do this, I know if I spend enough time I'll figure out some way of doing it. I know it's happened before the same way. "

–Matt, follow-up interview, 2015

Future Considerations

- Expand the number of ISLE lab sections from 8 -> 16 (all).
- Define what are the long-term learning goals

- Additional lines of inquiry
  - Gender differences
  - Discrepancy between skills learned and assessment
  - Improve buy-in from all students

- Start working on other courses (IPLS!)

THANK YOU

- Steven Jackson, TA from the beginning (!)
- Rick Soden, Lab technician extraordinaire
- Eugenia Etkina and Anna Karelina for all their materials and general support.
- My coauthors: Catherine Riihimaki, Carolyn Sealfon, Evelyn Laffey