

Physics Lab Inventory of Critical thinking (PLIC)

Data Sources

Interested in using the PLIC in your class?

You can fill out the course information survey at <http://cperl.lasp.cornell.edu/PLIC> and you will be automatically sent a link to the PLIC for your course.



Data presented here was collected over the 2017-2018 academic year and includes:

data from 25 courses across 12 institutions.

2681 valid CR surveys.

352 coded valid OR surveys.

Scoring the PLIC

Item Classification	Criteria
Expert (E)	Picked by >50% of experts
Partial-Expert (P)	Picked by 30-50% of experts
Novice (N)	Picked by <10% of experts
Other	Other

Possible Scores	Criteria
1	At least one E response, no N responses
0.75	At least one E response, at least one N response
0.5	At least one P response, no E responses, no N responses
0.25	At least one P response, at least one N response, no E responses
0	Other

Group 1

Measure 10 repeated trials

Use 2 masses

Calculate k in each case and compare

Students described “evaluating a model” as finding k

Group 2

Measure two repeated trials

Use 10 different masses

Linearized plot, residuals, find k

Trend motivates need for intercept

- Likert-style questions ask respondents to evaluate how well data agree with a model or how well a particular group tested the model.
- Respondents were then asked to elaborate on their reasoning to the Likert-style questions and to suggest what the group should do next (B.R. Wilcox & S.J. Pollock, *Phys. Rev. Phys. Educ. Res.* **10.2**, 020124 (2014).)
 - These questions were in either an Open-Response (OR) or Closed-Response (CR) format:

OR

Respondents typed their answers into an open textbox.

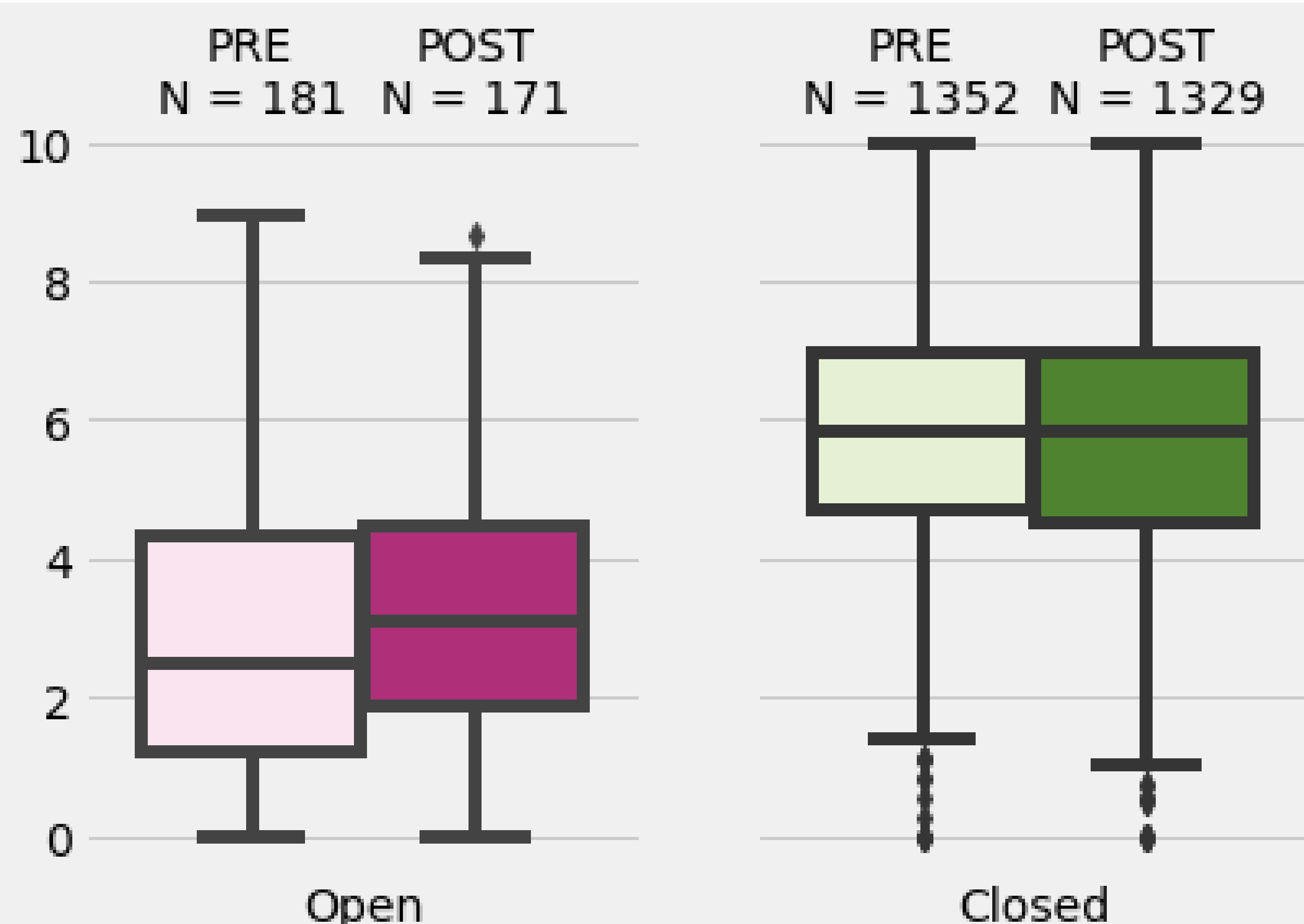
CR

Respondents were given 5-10 options to choose from and limited to selecting no more than 3 options.

What are these two instruments measuring?

*A.F. Heckler & A.M. Bogdan, *Phys. Rev. Phys. Educ. Res.* **14.1**, 010120 (2018)

HUGE differences between student performance on OR and CR assessments!



OR and CR Means are statistically different (unpaired t-test, $p < 0.01$).

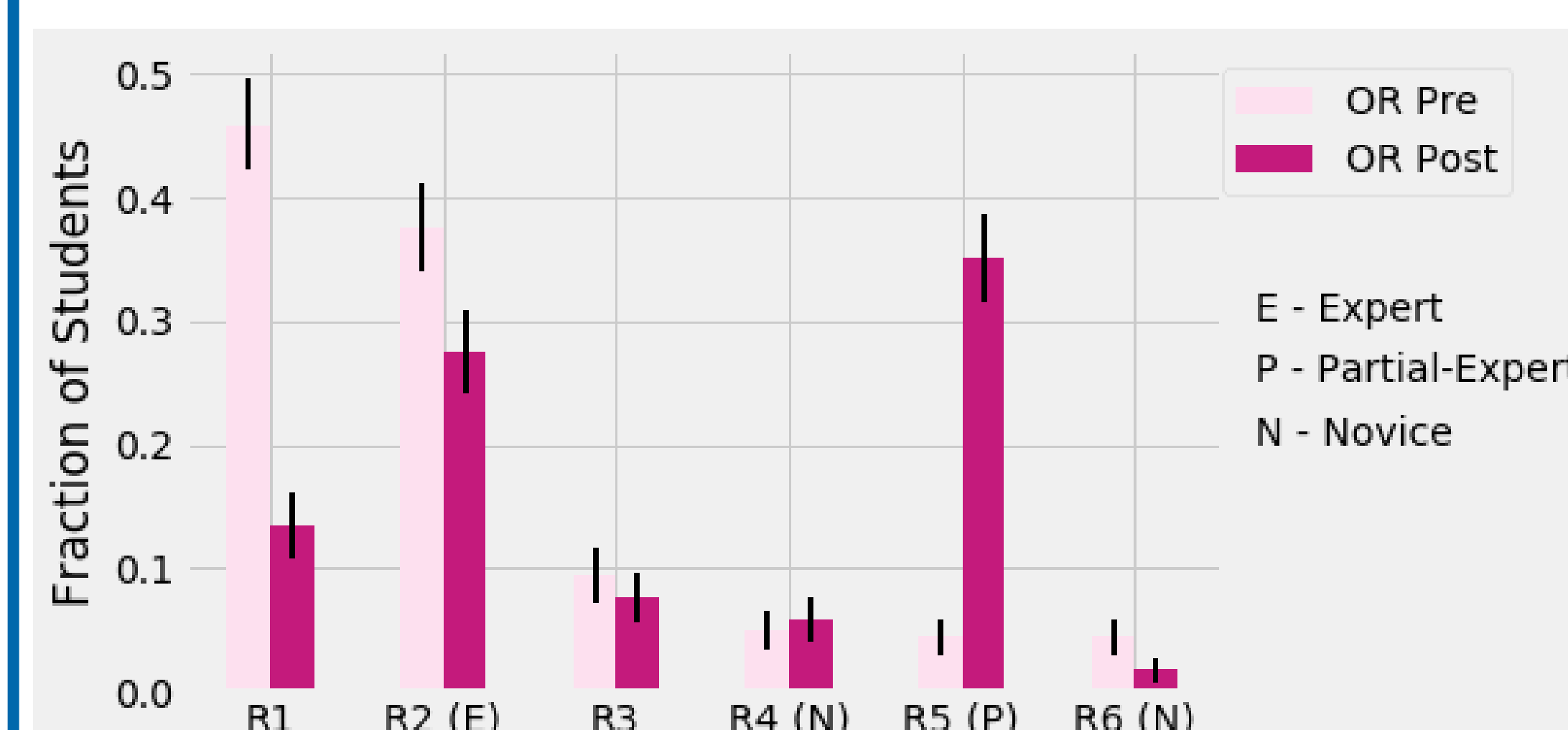
Pre-post shifts are not statistically significant for either format ($p > 0.1$).

Weighting by the number of options selected by a student, there are evident differences in responses to the two survey!

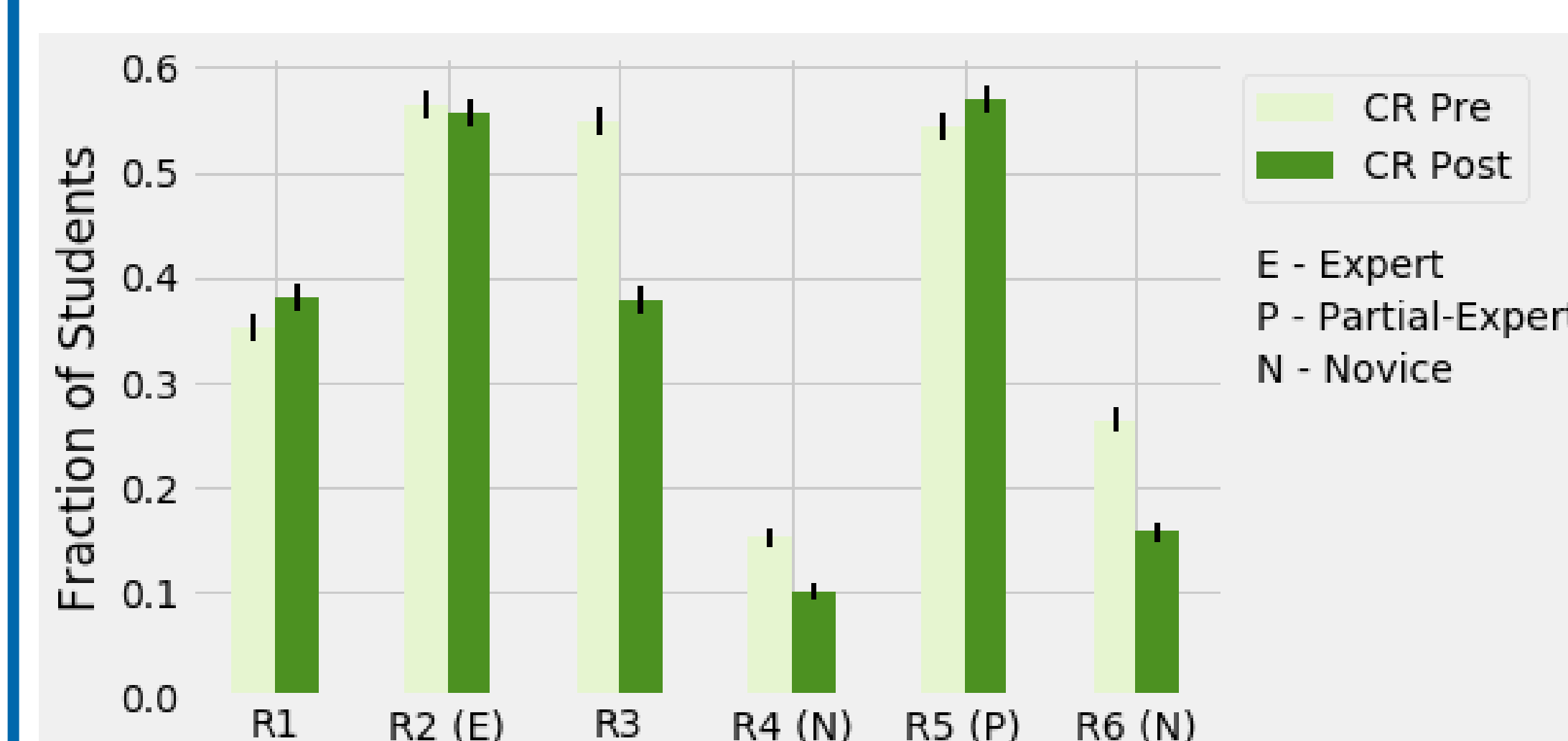
Example Question from the PLIC: What features were most important in comparing the two k values?

- ☐ R1—the difference between the two k values
- ☐ R2—the difference between the k values compared to the uncertainty
- ☐ R3—the percent difference between the k values
- ☐ R4—the difference between the two periods
- ☐ R5—the size of the uncertainty
- ☐ R6—how they accounted for human error

*Accessibility: what comes to mind

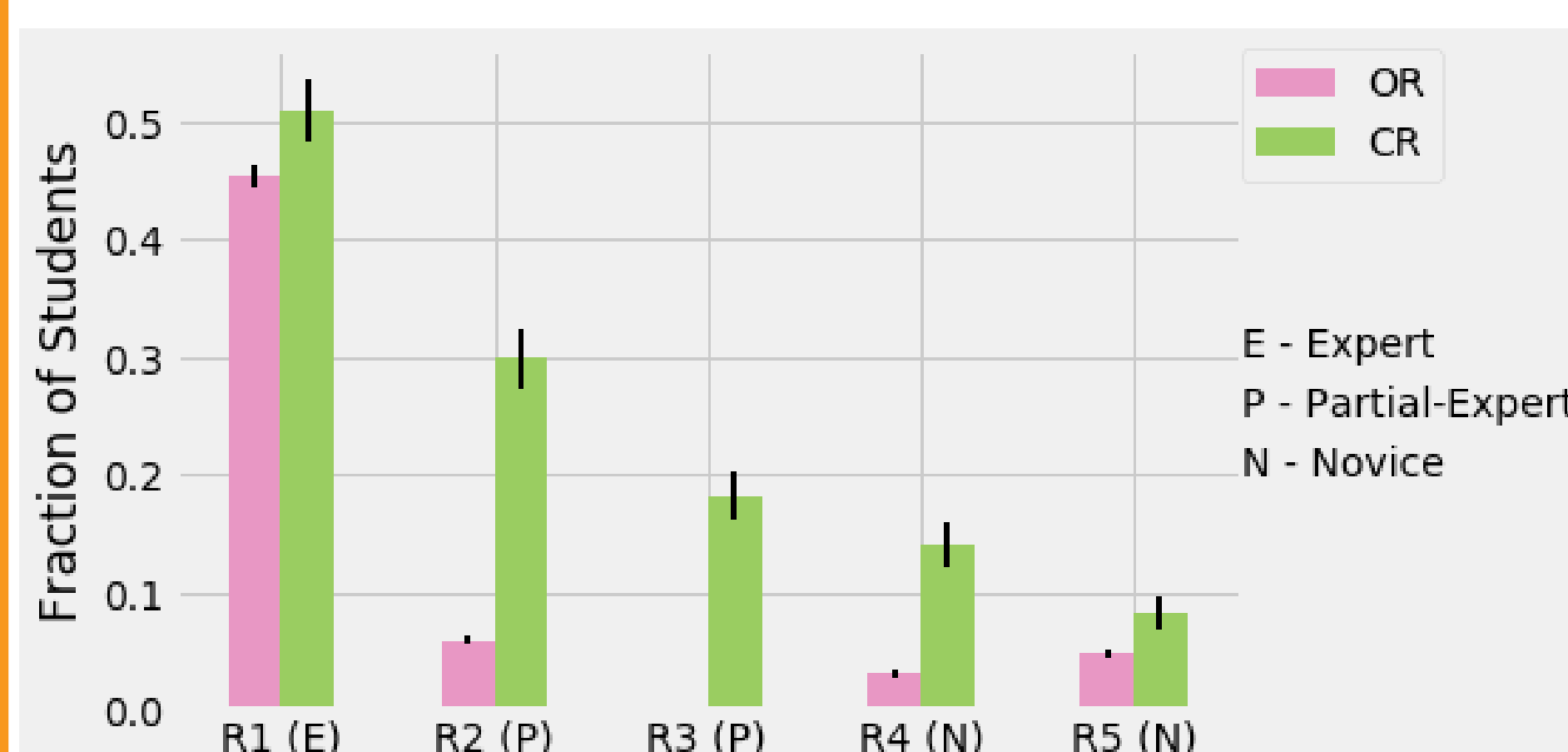


*Availability: knowledge activated by context

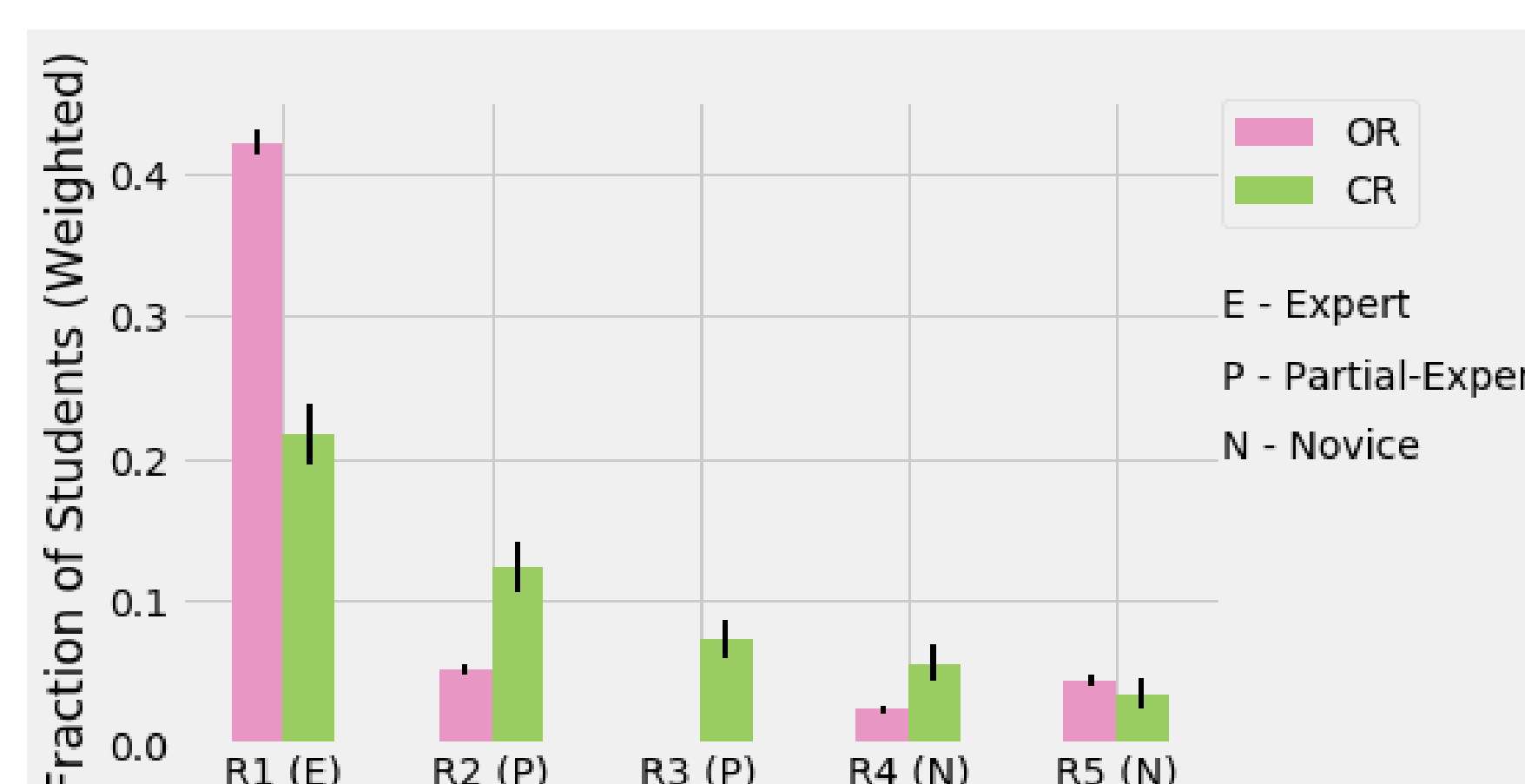


Example Question from the PLIC: What do you think Group 1 should do next?

- ☐ R1—Test more masses
- ☐ R2—Test other variables
- ☐ R3—Graph the results
- ☐ R4—Include other measures of uncertainty
- ☐ R5—Write it up



Weight students' responses by number of items selected



Future Work

- We plan to investigate these differences in availability and accessibility of resources in a physics lab context further using the PLIC.
- We also intend to investigate the role that instruction in different lab types plays in developing the availability or accessibility of particular resources.