

# Comparing Student Performance across Closed-Response and Open-Response Assessments

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Novice (N)

Other

Interested in using the PLIC in your class?

You can fill out the course information

http://cperl.lassp.cornell.edu/PLIC and

you will be automatically sent a link to the

## Physics Lab Inventory of Critical thinking (PLIC)

Two groups conduct an experiment to test the model:  $T = 2\pi \sqrt{\frac{m}{k}}$ .

## Group I

Group 2

Measure 10 repeated trials

Measure two repeated trials

Use 2 masses

Use 10 different masses

Calculate k in each case and compare

Students described "evaluating a model" as finding k

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.

### Data Sources

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 Picked by >50% of e Expert (E) Partial-Expert (P) Picked by 30-50% of

Criteria	Possible Scores	Criteria
Picked by >50% of experts  Picked by 30-50% of experts	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
Picked by <10% of experts	0.25	At least one P response, at least one N response, no E responses
Other	0	Other

**Example Question from the PLIC: What features** 

R2 — the difference between the k values compared to the

☐ RI—the difference between the two k values

□ R3 — the percent difference between the k values

□ R4 — the difference between the two periods

☐ R6 — how they accounted for human error

□ R5 — the size of the uncertainty

were most important in comparing the two k values?

\*Accessibility: what comes to mind

OR Pre

OR Post

P - Partial-Expert

CR Pre

E - Expert

N - Novice

survey at

PLIC for your course.

## What are these two instruments measuring?

uncertainty

ent 9.0

Stude

Fraction 0.0

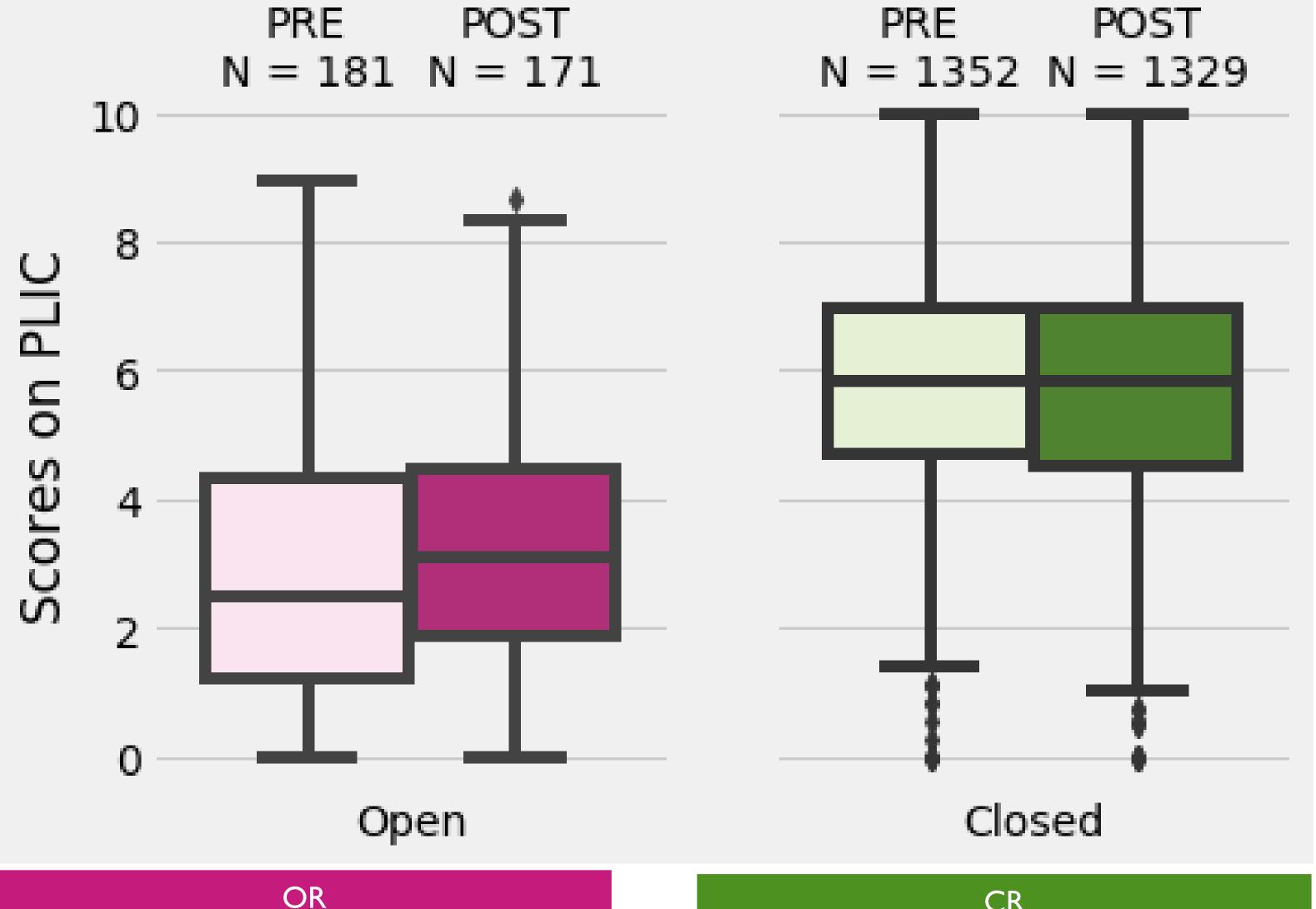
0.0

0.6

0.0

\*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!



(unpaired t-test, p << 0.01). Pre-post shifts are not

OR and CR Means are

statistically different

statistically significant for either format (p > 0.1).

- Median completion time = 17.8min
- Mean of total scores: 3.13±0.11
- Mean number of coded options per question ranges from 1.1 to 1.4
- 'Other' response identified by 29% of students

### CR

- Median completion time = 15.1min
- Mean of total scores: 5.68±0.03
- Mean number of selected options per question ranges from 2.3 to 2.7
- Student interviews indicate that respondents select what they would've written plus additional options
- 'Other' option selected by 12% of students

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 do you think Group I should do next?

- □ RI Test more masses
- □ R2 Test other variables
- ☐ R3 Graph the results

R2 (P)

R1 (E)

R3 (P)

of Students CR CR E - Expert P - Partial-Expert Fraction 5.0 N - Novice

R4 (N)

- □ R4 Include other measures of uncertainty □ R5 — Write it up
- Fraction of Students (Weighte OR Weight students' E - Expert P - Partial-Expert responses by N - Novice number of items selected

R3 (P)

R5 (N)

### Students o o 4 CR Post E - Expert P - Partial-Expert N - Novice **6**.0 **6** ction 0.2 .о. д

\*Availability: knowledge activated by

context

## Future Work

R5 (P)

- 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.