Current Assessment Format

Goal: To assess critical thinking skills of students in college-level, introductory lab courses.

Design: The PLIC is a closed-response survey. A traditional format of “choose one multiple choice” would be inadequate for our purpose. Here different follow-up questions appear based on student response. The design and format were modeled after Wilcox and Pollock’s (2016 Phys. Rev. PER.) multiple-choice on student response. The design and format were modeled after Wilcox and Pollock’s (2016 Phys. Rev. PER.) multiple-choice on student response. The design and format were modeled after Wilcox and Pollock’s (2016 Phys. Rev. PER.) multiple-choice on student response. The design and format were modeled after Wilcox and Pollock’s (2016 Phys. Rev. PER.) multiple-choice on student response. The design and format were modeled after Wilcox and Pollock’s (2016 Phys. Rev. PER.) multiple-choice on student response.

Context for PLIC

Given a set of standard lab equipment, test the model of harmonic motion from Hooke’s law for a mass on a spring:

\[ T = 2 \pi \sqrt{\frac{m}{k}} \]

Graph square of period for 10 different masses.

Two fictional groups have different methods to test the simple model of a mass on a spring. Students are asked to assess the methods, the fictional data, suggest next steps and compare the two groups.

Thinking Behaviors

Through think-aloud validation interviews, we identified three main thinking behaviors exhibited by students as they take the assessment, results which are useful not only to the PLIC but for all similar assessments.

**Cuing to Key Words**
- N = 5 students
- Select options with keywords learned in class, such as:
  - “Percent error”
  - “Human error”
- Common when answering questions related to Group 1 methodology.

To switch students from cuing to discerning, familiar material needs to be presented in an unfamiliar way (such as data in Group 2 rather than Group 1).

**Discerning**
- N = 10 students
- Considering all options presented, and selecting only a few after careful evaluation.
- Different students prioritize different answers, such as those related to:
  - “Human error”
  - Data collection
  - Model breakdown
- The answers selected reflect the sophistication (novice-like or expert-like) of their critical thinking.
- Some students, when exhibiting this behavior, change their initial judgment or assessment after seeing all other options presented.

Only when students are discerning in their choices can we assess their critical thinking.

**Selecting all Options**
- N = 3 students
- Selecting all options that appeal, regardless of priority or importance.
- All closed response option for the PLIC are “correct” in some way, and so this behavior is not associated with critical thinking and may be a symptom of the assessment design.

To switch students from selecting all options to discerning, students must be told to select a limited number of answers (no more than three).

Developing the Assessment


**Phase 1: Conception**
- Delineation of the purpose of test and chose topic.
- Collect and create data.
- Initial data created by a physicist conducting the experiment.
- Initial questions based on their self-questions related to their choice of methods, data and collection.

**Phase 2: Open-Response**
- Development of open-response version.
- Student interviews conducted.
- Student written responses gathered from introductory class.
- Experts consulted.
- Results previously presented.[5]

**Phase 3: Closed-Response**
- Development of the closed-response version based on open responses.
- Currently using the online survey software *Qualtrics*.
- Field testing though think-aloud validation interviews.
- Develop scoring.

We are currently in Phase 3.

**Phase 4: Operational Use**
- Assemble and evaluate the test for operational use.
- Large-scale validation, reliability and validity testing.
- Easy access for instructors, with automation for setup, reminders and report-back scoring similar to Wilcox et. al. (2016 Phys. Rev. PER).