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## Implementation

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### Purpose of the E-CLASS

To assess students' perceptions of the gap between classroom laboratory instruction and professional research. The E-CLASS was developed in response to frequent calls to transform laboratory curricula to more closely align it with the skills and abilities needed for professional research. At the beginning and end of the semester, the E-CLASS assesses students' views about their strategies, habits of mind, and attitudes when doing experiments in lab classes. Students also reflect on how those same strategies, habits of mind, and attitudes are practiced by professional researchers. Finally, at the end of the semester, students reflect on how their own course valued those practices in terms of earning a good grade.

### Course Level: What kinds of courses is it appropriate for?

Upper-level, Intermediate, and Intro college

### Content: What does it assess?

Beliefs / Attitudes (affect, confidence, math-physics-data connection, physics community, uncertainty, troubleshooting, argumentation, experimental design, modeling)

### Timing: How long should I give students to take it?

15 minutes

### Example Questions

Sample question from the E-CLASS:

**1. When doing an experiment, I try to understand how the experimental setup works.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

What do YOU think when doing experiments for class? ○ ○ ○ ○ ○

What would experimental physicists say about their research? ○ ○ ○ ○ ○

**2. If I wanted to, I think I could be good at doing research.**

Strongly Disagree 1 2 3 4 5 Strongly Agree

What do YOU think when doing experiments for class? ○ ○ ○ ○ ○

What would experimental physicists say about their research? ○ ○ ○ ○ ○

### Access: Where do I get the assessment?

Download the assessment from physport at [www.physport.org/assessments/ECLASS](http://www.physport.org/assessments/ECLASS).

### Versions and Variations: Which version of the assessment should I use?

The latest version of the E-CLASS, released in 2013, is version 2. Version 1 was released in 2012, and then changes were made to the phrasing of the prompts and in response to interviews with students.

### Administering: How do I give the assessment?

- Administer it online through the developers' website: <https://jila.colorado.edu/lewandowski/research/eclass-instructors-0>. The developers will ask you to complete a Course Information Survey and then will set up and score the test for you.
- Give it as both a pre- and post-test. This measures student learning.
  - Give the pre-test before you cover relevant course material.
  - Give the post-test at the end of the term.
- Use the whole test, with the original wording and question order. This makes comparisons with other classes meaningful.
- Make the test required, and give credit for completing the test (but not correctness). This ensures maximum participation from your students.

- Tell your students that the test is designed to evaluate the course (not them), and that knowing how they think will help you teach better. Tell them that correctness will not affect their grades (only participation). This helps alleviate student anxiety.
- For more details, read the **PhysPort Guides** on implementation:
  - **PhysPort Expert Recommendation on Best Practices for Administering Belief Surveys**  
([www.physport.org/expert/AdministeringBeliefSurveys/](http://www.physport.org/expert/AdministeringBeliefSurveys/))

### Scoring: How do I calculate my students' scores?

- The overall E-CLASS score is the percentage of questions where a student agrees with the expert response. (Dis)agree and strongly (dis)agree are counted as equivalent responses. Student responses to individual items are coded simply as favorable (+1), neutral (0), or unfavorable (-1).
- Students' overall E-CLASS score is given by the sum of their scores on the individual items on the 3-point scale described above. This results in a range of possible scores from -30 to 30 points.
- Students' numerical E-CLASS scores are determined only by their responses to the prompt targeting their personal beliefs, rather than their prediction of what an experimental physicist would say.
- Score the E-CLASS through the developers' website (<https://jila.colorado.edu/lewandowski/research/eclass-instructors-0>). Their system will score the test and prepare a report summarizing the results for your course and comparing them to other courses. You can see a sample report here: [http://jila.colorado.edu/~eclass/-CU%20Boulder\\_2015\\_12/report.html](http://jila.colorado.edu/~eclass/-CU%20Boulder_2015_12/report.html)

### Clusters: Does this assessment include clusters of questions by topic?

There are no clusters of questions on the E-CLASS. It was not designed with any a priori categorization of questions, and a post-hoc Principle Components Analysis did not find strong factors.

### Typical Results: What scores are usually achieved?

Typical Results from [Wilcox and Lewandowski 2015](#) scored on a 3-point scale where a favorable response = +1, a neutral response = 0, and an unfavorable response = -1.

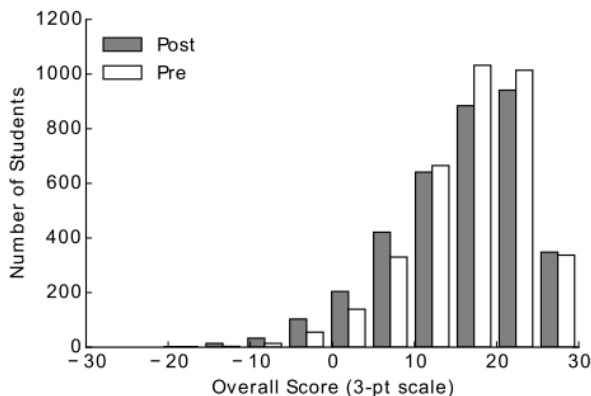
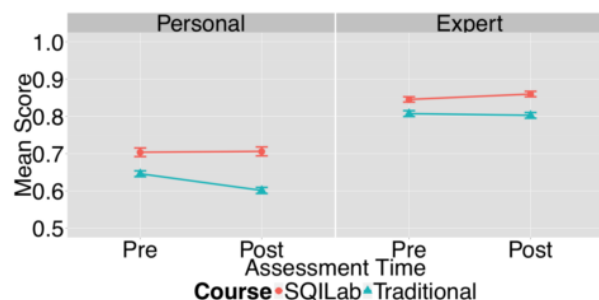


FIG. 2. Distribution of students pre- and post-instruction E-CLASS scores for students with matched pre- and post-scores ( $N = 3591$ ). The average E-CLASS score was  $16.5 \pm 0.1$  points ( $\sigma = 6.8$ ) for the pretest, and  $15.4 \pm 0.1$  points ( $\sigma = 7.9$ ) for the post-test. The difference between the two distributions is statistically significant (Mann-Whitney U [26],  $p < 0.05$ ).

**Typical Results** from [Holmes, Ives and Bonn, 2014](#) showing average fraction of favorable (expert-like) responses (0 = unfavorable response or neutral response, 1 = favorable response). The figure below represents a significant drop in students' personal beliefs in the traditional lab ( $n=453$ ) and a neutral shift in Structured Quantitative Inquiry Labs (SQLab) students' personal beliefs ( $n=127$ ), where the SQLab refocus the scope of the learning outcomes to promote mastery only on data handling, measurement, and uncertainty concepts and experimentation skills.



### Interpretation: How do I interpret my students' scores in light of typical results?

Your E-CLASS results are especially useful for comparing shifts in students' expert-like beliefs before and after you have made a change to your teaching, for example, trying teaching methods that explicitly focus on developing expert-like beliefs around lab skills. You can compare the shifts in expert-like beliefs before and after you try new teaching techniques as one measure to gauge the effectiveness of the techniques. Typical results on the E-CLASS show negative shifts in students' beliefs from pre- to post-test, and no shift when there is an explicit focus on understanding the process of science through reflection, iteration, and improvement.

## Resources

### Where can I learn more about this assessment?

B. Zwickl, N. Finkelstein, and H. Lewandowski, [Development and Validation of the Colorado Learning Attitudes about Science Survey for Experimental Physics](#), presented at the Physics Education Research Conference 2012, Philadelphia, PA, 2012.

### Translations: Where can I find translations of this assessment in other languages?

You can download translations of this assessment in the following languages from [PhysPort](#):

- **Amharic** translated by Yohanes Wolde-Senbet
- **English**
- **Italian** translated by Barbara Arfè, Enrico Toffalini, Alessandro Sfondrini, Giovanni Organtini, Eugenio Tufino
- **Swedish** translated by Johan Henriksson

If you know of a translation that we don't have yet, or if you would like to translate this assessment, please [contact us!](#)

## Background

### Similar Assessments

The E-CLASS is modeled on the Colorado Learning Attitudes about Science Survey ([CLASS](#)), a general survey of students' attitudes and beliefs about physics classes. The questions on the E-CLASS have been adapted to target laboratory classes and other experimental contexts.

### Research: What research has been done to create and validate the assessment?

**Research Validation:** Gold Star ★

This is the highest level of research validation, corresponding to all seven of the validation categories below.

- ✓ Based on research into **student thinking**
- ✓ Studied using **student interviews**
- ✓ Studied using **expert review**
- ✓ Studied using **appropriate statistical analysis**
- ✓ Research conducted **at multiple institutions**
- ✓ Research conducted **by multiple research groups**
- ✓ **Peer-reviewed publication**

## Research Overview

The Likert-scale questions on the E-CLASS were developed based on consensus learning goals defined by faculty at the University of Colorado at Boulder for their lab curriculum. The questions were modeled after questions on the CLASS and based on common challenges instructors observed students having in lab courses. The E-CLASS was tested in over 40 student interviews with physics majors, non-majors and introductory physics students to ensure questions were being interpreted in the way intended. Further, over 20 experts reviewed the E-CLASS and indicated their view of the expert-like response for each question. Students in upper-division physics labs gave a larger fraction of expert-like responses than students in algebra-based physics labs in both the classroom context and in the context of professional research. The E-CLASS was given to over 5500 first year, intermediate and upper-division students (about 3500 matched pre and post) at over 45 institutions and appropriate statistical analyses of reliability and discrimination were performed. Reasonable results were found. The E-CLASS has been given to over 5500 students at over 45 institutions with results published in 6 peer-reviewed papers.

## Developer: Who developed this assessment?

Ben Zwickl and Heather Lewandowski

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