



Assessing Advanced Physics Laboratory

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Objectives

- Study the overall educational effectiveness of advanced physics lab at the Colorado school of Mines (CSM)
- Assess student performance
- Study whether “preview” or “review” of concepts is preferable

Advanced Lab at CSM

CSM requires all physics majors to complete a two semester advanced laboratory sequence. This course is primarily attended by juniors with a few seniors. There are two sections each with ~30 students for a total enrollment of ~60 students per year. It is worth noting that CSM perennially has one of the top five highest enrollments of physics majors in the United States. This study was performed on the second semester of this sequence.

Class Details

The course focuses on radiation detection and measurement. The class self-selects groups of three which are then randomly assigned a group letter. The letter of the group determines which labs the group will do. Out of a possible eight labs, each group completes five. Every group does labs one and two, with the others depending on the group's letter. The labs are:

- Constructing a Scintillating Detector
- Attenuation of Gamma Rays
- Compton Scattering
- Attenuation of Alpha Particles
- Alpha – Gamma Coincidence
- Gamma – Gamma Coincidence
- Measurement of Cosmic Rays
- Muon Lifetime

Global Assessment

Students were given a Global Concept Assessment (GCA) developed by the authors at the beginning and end of the semester. This was the primary assessment tool for determining learning outcome. The GCA consisted of two short answer problems, ten fill in the blank and eleven multiple choice questions. The content of the GCA was written such that all important concepts for the lab were touched upon. Absolute and relative improvements between pre and post semester were calculated to determine overall effectiveness of the teaching of these concepts.

Preview vs. Review

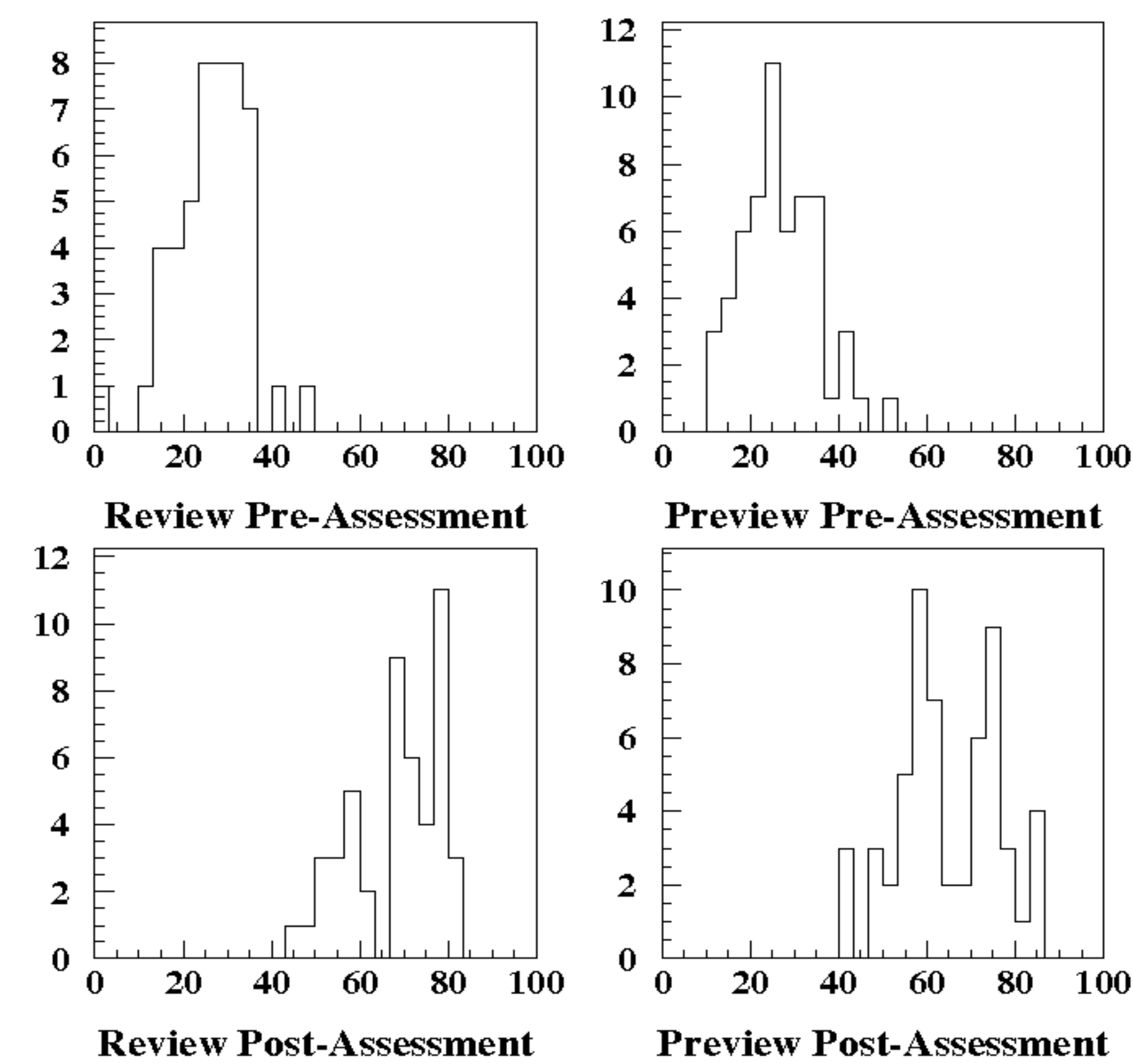
In addition to the assessment of overall performance, the effect of previewing to reviewing laboratory material was investigated in relation to student performance. To achieve this, short “mini-quizzes” consisting of three to four short answer conceptual questions specific to each lab were written. One section of the lab was selected as the “preview section” and the other as the “review section”. Each week, the preview section's groups completed the quiz corresponding to their lab right before beginning class. The review section would complete their quizzes right after completing the lab that week. The GCA was then used as a tool to assess whether there were any significant performance differences in students that “previewed” or “reviewed” course material.

The Dataset

Analysis was performed on the Spring 2009 and Spring 2010 classes, four sections in all, two preview and two review sections. Only students that took both legs of the GCA were included in the final analysis. In all there were:

57 preview students
48 review students

Absolute Improvement



These distributions are the raw percentage pre and post-assessment data for both review and preview groups. The mean and standard deviation for each distribution is:

Review Group

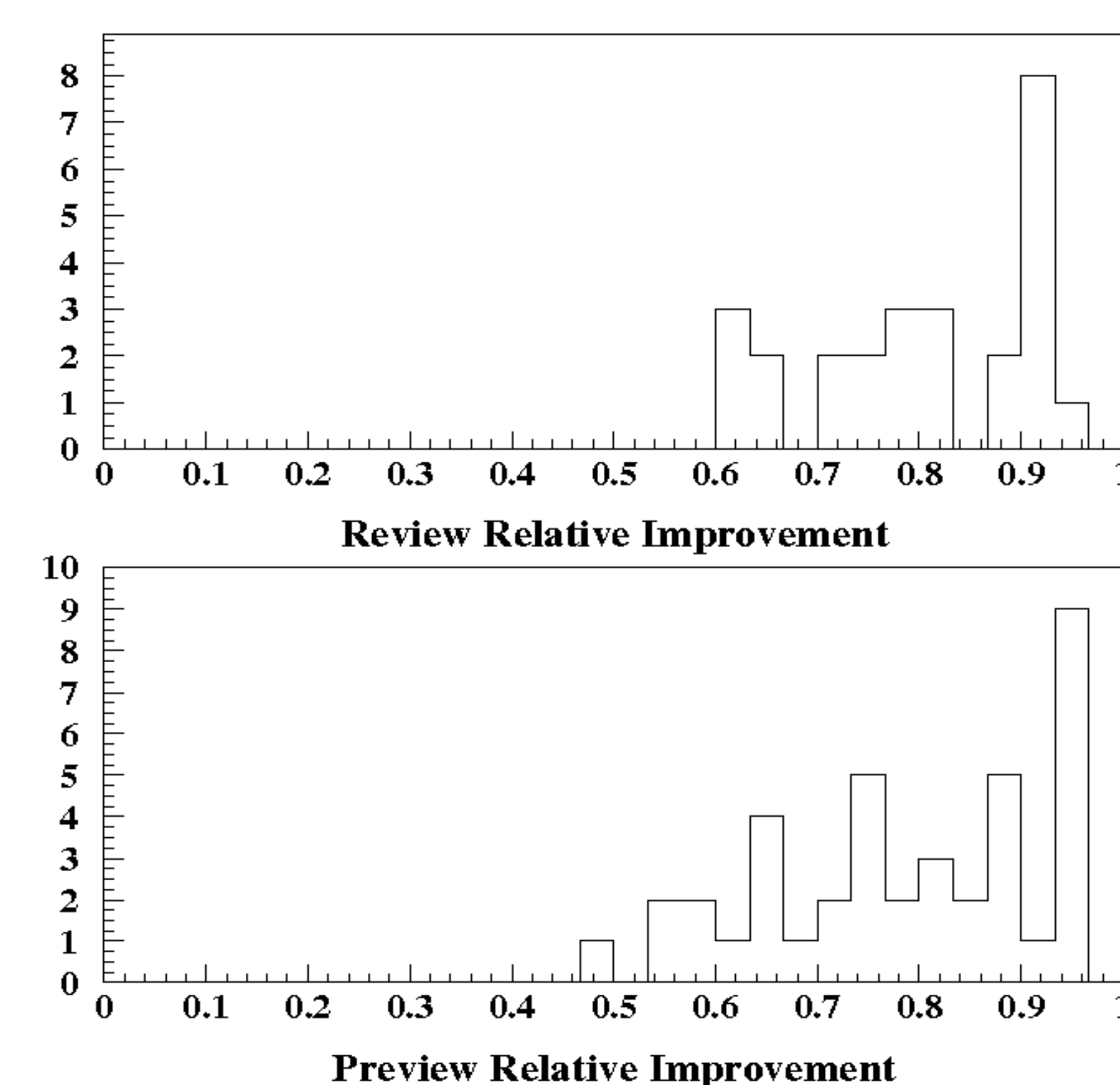
Pre-Assessment: 26.5% +/- 8.2%
Post-Assessment: 68.4% +/- 10.0%

Preview Group

Pre-Assessment: 26.8% +/- 8.7%
Post-Assessment: 64.8% +/- 11.4%

A t-test shows improvement for both groups at $p < 0.01$.

Relative Improvement



Relative Improvement Contd.

The difference in relative improvement between preview and review as measured by the GCA is not statistically significant. There is a slight absolute preference to review vs. preview that was seen in both 2009 and 2010. However, the difference was not enough to be statistically significant.

Discussion

The absolute scores on the GCA show an improvement for all students at a high level of statistical significance. This was independent of whether the students were part of the preview or review quiz group. This result is encouraging since it demonstrates that students retain key concepts by the end of the semester and do improve their knowledge. The relative improvement scores between preview and review do not show a statistically significant preference, however. This indicates that quizzing students before or after lab are similarly effective at improving learning outcome. Results comparing preview and review quizzing to no quizzing is future work.

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Reference

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