

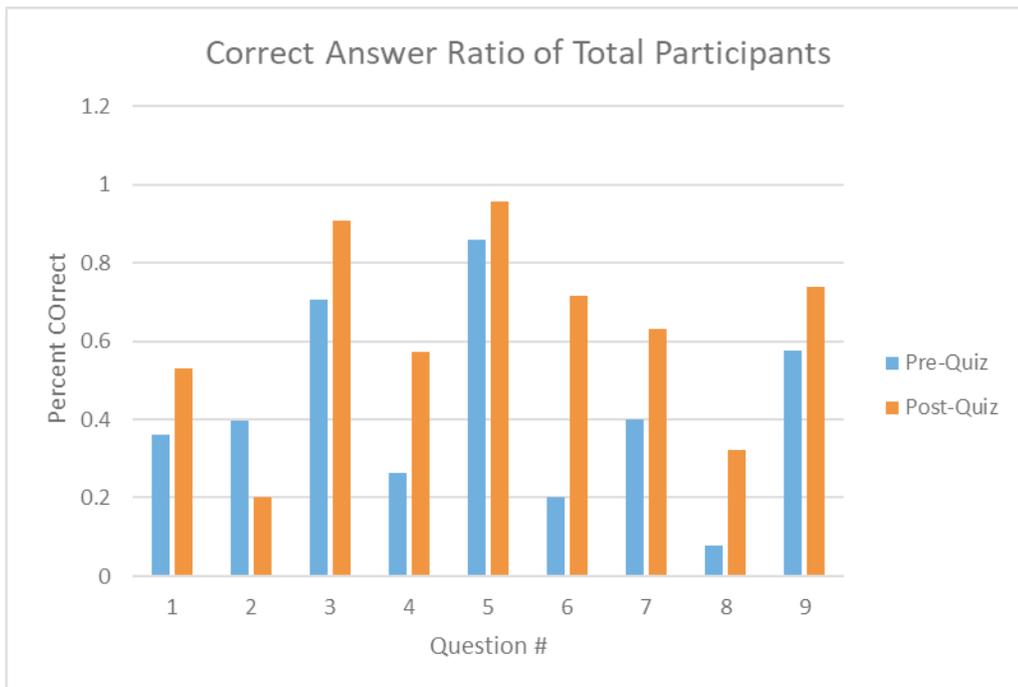
As a way to measure course effectiveness, the USU Physics department administers a Pre and Post quiz to students in the Introductory, calculus-based physics courses. The Pre and Post quiz have the same set of 10 questions. Students have the opportunity to take the pre-quiz during the first week of the semester and the post-quiz during the last week of the semester. There is no requirement to participate but students earn a bonus point for each test that counts towards their final grade as incentive.

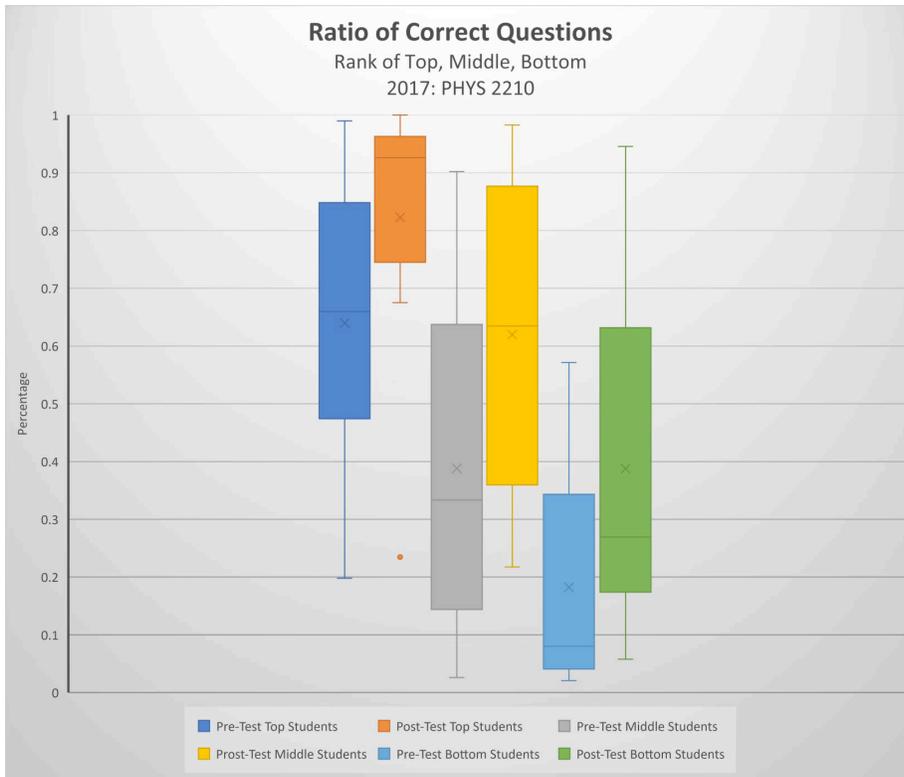
This study shows a Pre and Post quiz analysis from the Spring and Fall Semesters of 2017.

The course held in Spring 2017 was numbered 2210 and covered Mechanics, Waves, and Thermodynamics. There were 10 questions offered to the students. 9 of which were concept based. One asked an open-ended question about hours expected to study and hours actually studied. This question will be omitted in the following analysis. There were 242 students who participated in both the Pre and Post quiz this semester. The average score of the 305 students who took the Pre-Test was 38% with a high score of 90%, a low score of 0% and a standard deviation of 1.66 points. The average score of the 257 students who took the Post Test was 56%, with a high score of 90%, a low score of 0% and a standard deviation of 1.68 points. The average time taken to complete the Pre-Quiz was 8.25 minutes while it took an average of 9.5 minutes for the post-test.

As a side note: of the 242 students who took both the Pre/Post Test the average for the pre-test was 43% and the post test was 62%.

Below, Figure 1a, is a question specific representation of improvement. Ratio is of the total students who took the quiz (305 -Pretest, 257 Posttest). The questions with the most improvement seemed to be conceptual questions that did not require computation. (4,6,8). Question 2 is caused by a software answer error!





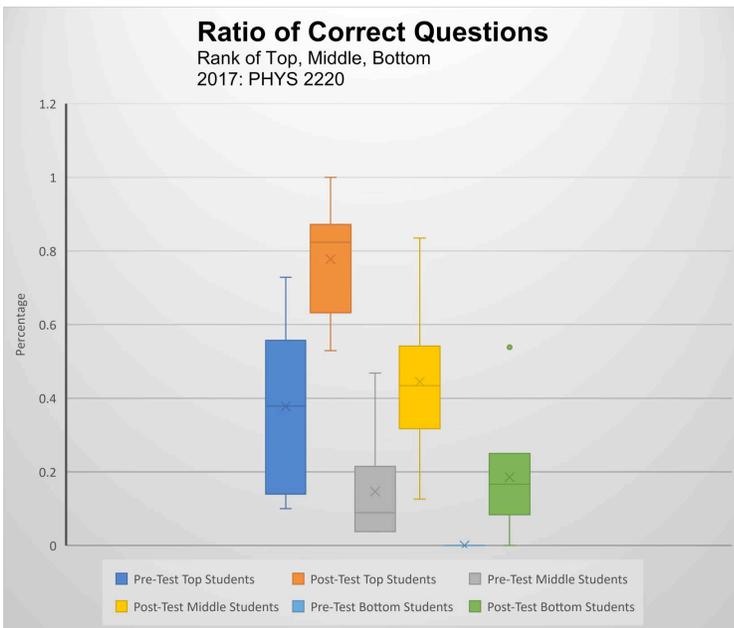
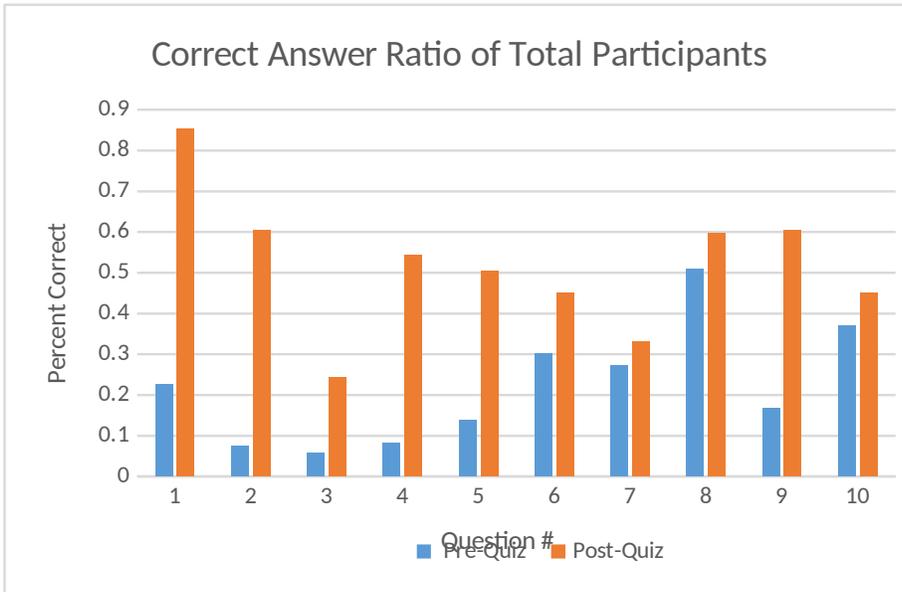
Figures 1a (upper panel) and 1b (lower panel) PHYS2210 Spring 2017 pre and post class average accuracy responses.

Figure 1b presents the same information by considering the student divided into three separate groups based on the students class performance in PHYS2210. The objective being to contrast the learning according to the students' class ranking. For this first analysis the relative change appears to be the same for each group over the course of the semester.

The course held in Fall 2017 was numbered 2220 and covered Electromagnetism, Optics, and Modern Physics. There were 10 questions offered to the students of which all 10 were concept-based. There were 156 students who participated in both the Pre and Post quiz this semester. The average score of the 173 students who took the Pre-Test was 22% with a high score of 60%, a low score of 0% and a standard deviation of 1.52 points. The average score of the 169 students who took the Post Test was 52%, with a high score of 100%, a low score of 0% and a standard deviation of 2.13 points. The average time taken to complete the Pre-Quiz was 5.5 minutes while it took an average of 7.5 minutes for the post-test.

As a side note: of the 156 students who took both the Pre and Post Test the average for the pre-test was 22% and the post test was 52%.

Below, Figure 2a, is a question specific representation of improvement. Ratio is of the total students who took the quiz (173 -Pretest, 169 Posttest). The questions with the most improvement were questions 1, 2, 4, 9.



Figures 2a (upper panel) and 2b (lower panel) PHYS2220 fall 2017 pre and post class average accuracy responses.

Figure 2b shows the analysis based on breaking the students population into three groups. The same scheme used in Figure 1b is repeated. Most noticeable is that for this course, the second semester of the calculus based introduction to physics for scientists and engineers the incoming performance percentages are significantly lower than for the first semester, Figure 1b. However the improvement is comparable if not slightly higher than for the earlier class.

Future Work: This is one year of a 5-year data set using the same Pre and Post question for both semesters of introductory calculus-based physics. Future work will involve doing a similar analysis or

previous years. These quizzes will continue to be administered in future years. By repeating the analysis for the prior years key questions can be addressed:

- 1) Are students showing the same scores when they enter PHYS2210 over these years?
- 2) Are students exiting with the same degree of improvement over the years?
- 3) Is the incoming performance for PHYS2210 always higher than that for PHYS2220?
- 4) Instructors and TAs do not review the pre and post test questions. There would be value to review for each question if the post-test scores are consistent with teaching emphasis in that area. This would also be a means of making a broader assessment of the success in the overall course objectives.