A Systematic Assessment of the Benefits of Active Learning in Undergraduate Aerodynamics

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Abstract

This work studies the effectiveness of one non-traditional lecture approach, based on in-class concept questions, on the performance of students in a core undergraduate Aerodynamics course. The motivation for this investigation comes from existing research showing the benefits of having students actively engaged in the learning process, for example through responding to concept questions and participating in follow-up discussions. The effectiveness of the approach is studied over two consecutive terms by varying the amount of time spent on concept questions in each term. Performance is assessed using four standardized quizzes and the final course grade. Student information pertaining to gender, ethnicity, and prerequisite grade were included in the study. Statistical analysis was conducted using repeated measures and univariate models. In all cases, no independent variable has a statistically significant impact.

Results

Sample Summary: 147 students
- 132 male, 14 female, 1 no data, 57 in Fall 2010, 90 in Winter 2011
- 98 White, 25 Asian, 10 other, 14 no data

Statistical Analysis

- Repeated measures: effects on quiz (2,3,4) scores

Future work:
- Perform a control study without concept questions
- Improve wording of standardized quizzes
- Code violations since the same quiz should ideally be used in both terms.

Discussion

- Lack of statistical significance in the repeated measures model means that we cannot draw conclusions on the benefits of concept-question-based active learning from this study.
- Only prerequisite performance was found to be a statistically significant and strongly-correlated predictor of the course grade.
- Qualitative assessment: class was more engaged and asked more well-formulated questions following concept questions.

Conclusion

- Improbable results are due to chance (and were not caused by a relationship between the indicated variables). By convention, significance < 0.05 is required to reject the null hypothesis.
- Observed Power: Probability of correctly rejecting the null hypothesis. Again by convention, power > 0.8 is desired.

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