

# The Nature and Extent of Students' Interactions with Online Multimedia Learning Modules

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## MLMs Improve Learning in Physics

Recent research provides evidence that the integration of multimedia learning modules (MLMs) into introductory courses improves learning and retention of physics content<sup>1,3,4</sup>. Yet, it is not fully clear how students use MLMs for learning. Making a MLM available for students to learn from does not guarantee that students will take advantage of the opportunity, even if it is a required course assignment. In this study, we investigate the nature and extent of students' use of MLMs by analyzing clickstream data from student interactions with SMART Physics.

## Research questions

1. Is there a credible difference in *exam* performance between viewers and nonviewers of MLMs?
2. Is there a credible difference in *course* performance between viewers and nonviewers of MLMs?

## Course Context

- Physics 251 is the first semester of a two-semester sequence on introductory calculus-based physics focusing on Newtonian mechanics and its applications. It constitutes four one-hour lectures per week and has a typical enrollment of between 80 and 100 students.
- Instructor assigned 24 prelectures (a type of MLM) to be viewed before attending face-to-face lecture classes over the course of the semester.
- Figure 1 provides an example of a scene viewed by students.

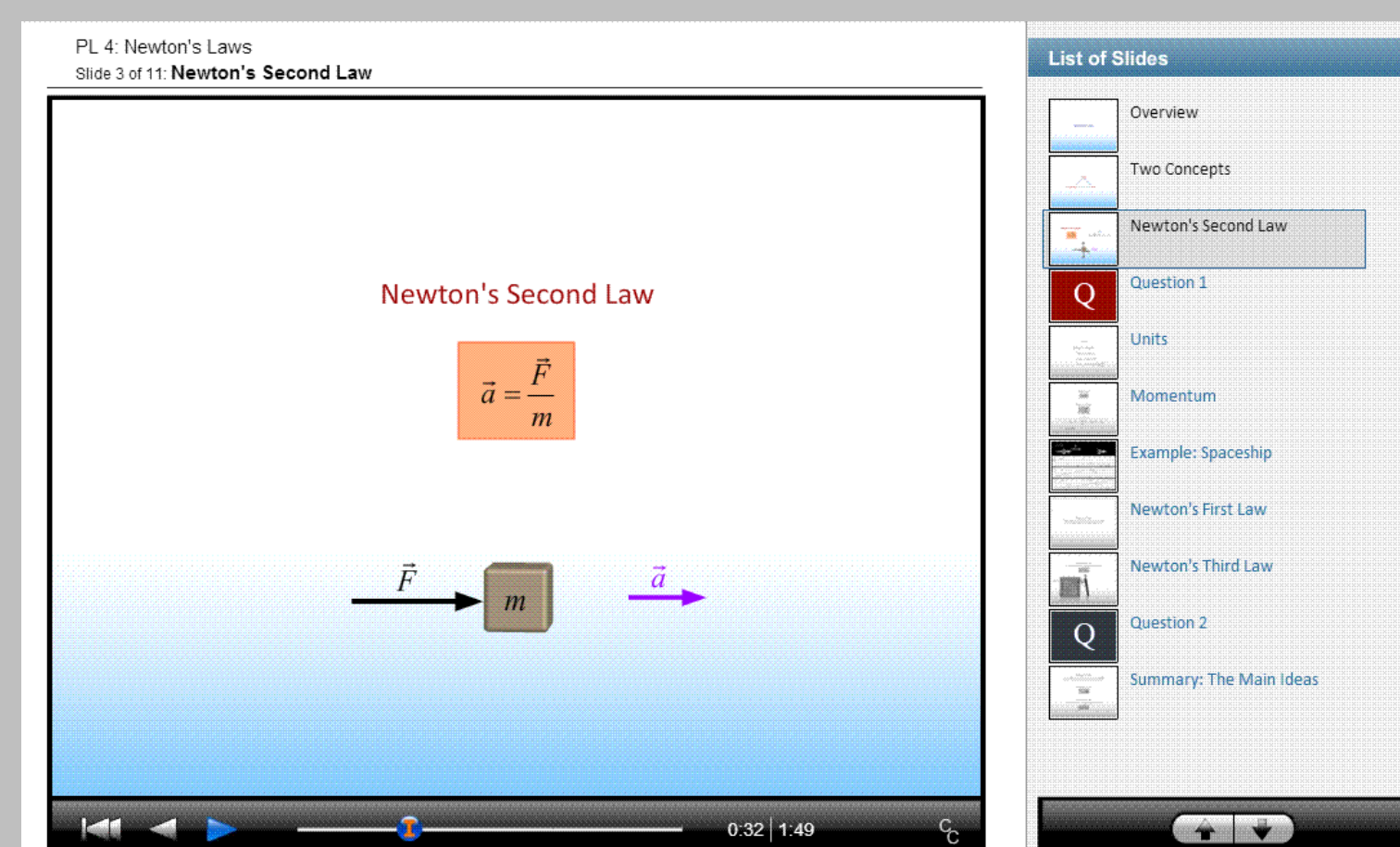


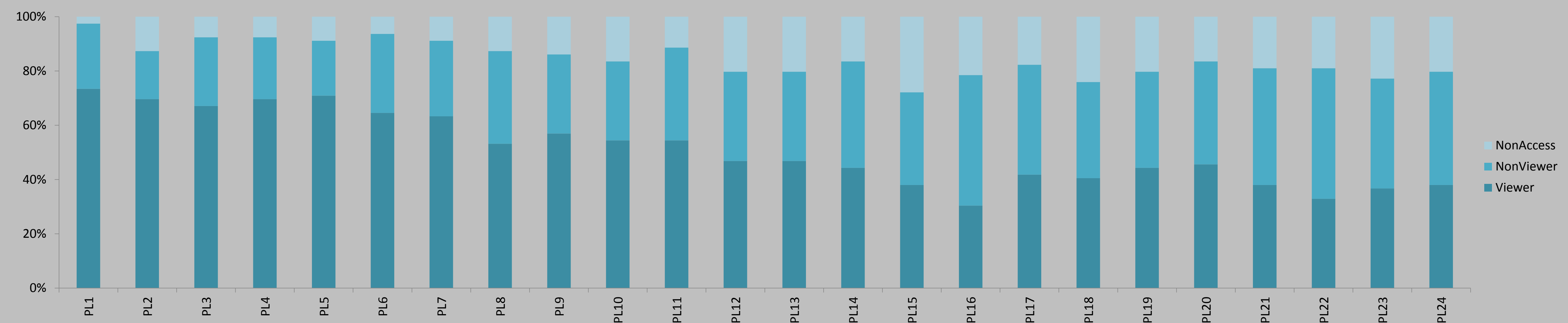
Figure 1. SMART Physics MLM example

## Data Collection

- We obtained clickstream data for all students from SMART Physics.
- Clickstream data contained timestamps for each click that advanced a student to the next scene.
- We calculated each student's viewing time for specific scenes based on elapsed time between successive timestamps.

## Classifying Students

- Identified a student as viewer, nonviewer, or nonaccess for each prelecture
  - Nonaccess: did not attempt to access the prelecture
  - Nonviewer: spent less than 75% of the scene duration for 3 or more scenes
  - Viewer: all remaining students
- Next, we separated students into viewer and nonviewer groups. The viewer group included students who were identified as a viewer for at least 75% of the prelectures, while the nonviewer group included all other students.



Graph 1. Percentage of students viewing online prelectures

## Decrease in Student Views

- Early in the semester, the majority of students (greater than 50%) were classified as viewers. However, near the end of the semester, viewers became the minority group (less than 50%).
- Early in the semester, the percentage of students classified as nonaccess was quite low (typically, less than 10%). However, 20% of the class were not attempting to access the prelectures near the end of the semester.

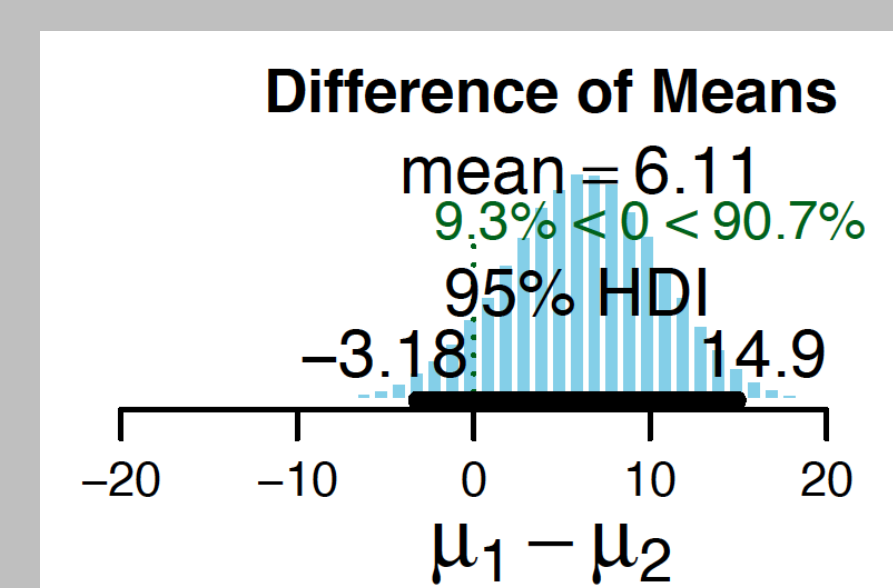


Figure 2. Exam 1

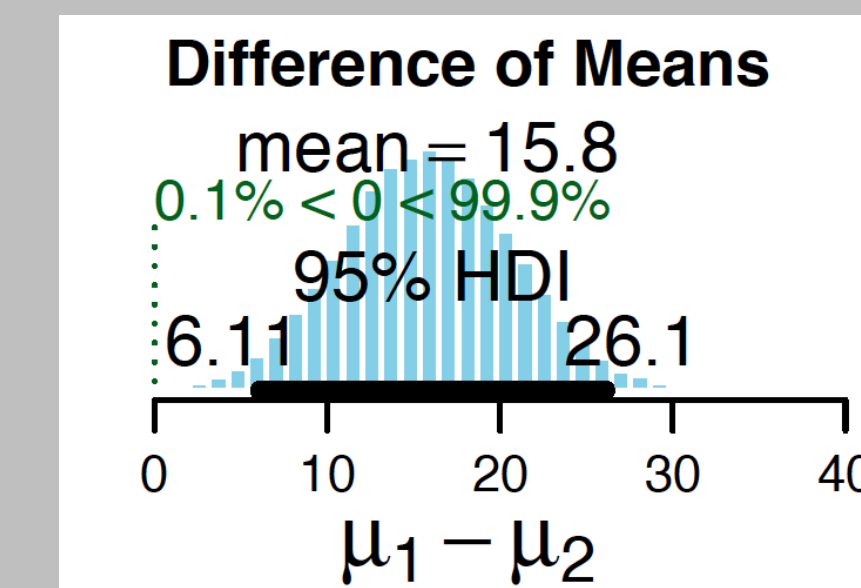


Figure 3. Exam 2

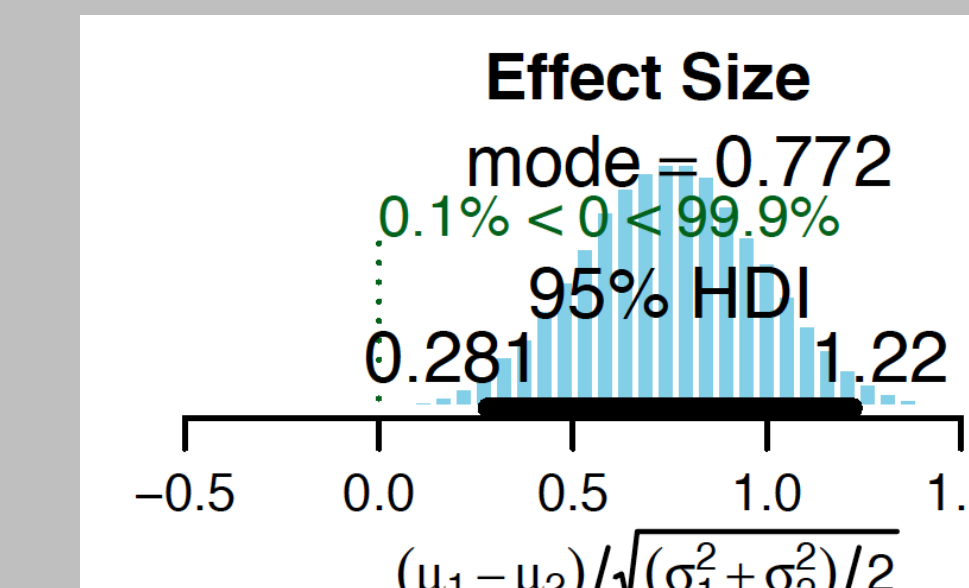


Figure 4. Exam 2

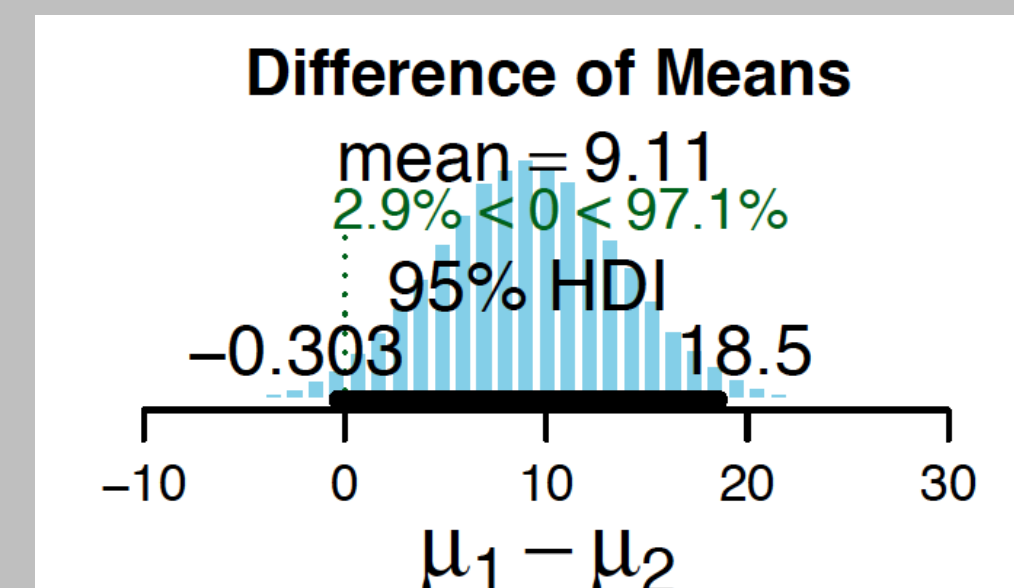


Figure 5. Exam 3

## Bayesian estimation of the difference between two groups based on exam performance<sup>2</sup>

- Our analysis revealed a credible non-zero difference in exam performance between viewers and nonviewers for Exam 2. Viewers earned a higher average exam grade than nonviewers. The posterior distribution for the difference of means yielded a mean difference of 15.8% with a 95% HDI ranging from 6.1% to 26.1% (Figure 3). The posterior distribution for effect size indicated a mode of .77 with a 95% HDI ranging from 0.28 to 1.22 (Figure 4).
- Our analysis did not identify a credible difference in exam performance between viewers and nonviewers for Exams 1 and 3 (Figures 2 and 5). The 95% HDI included 0, which means that 0 is a credible value for the difference between means.

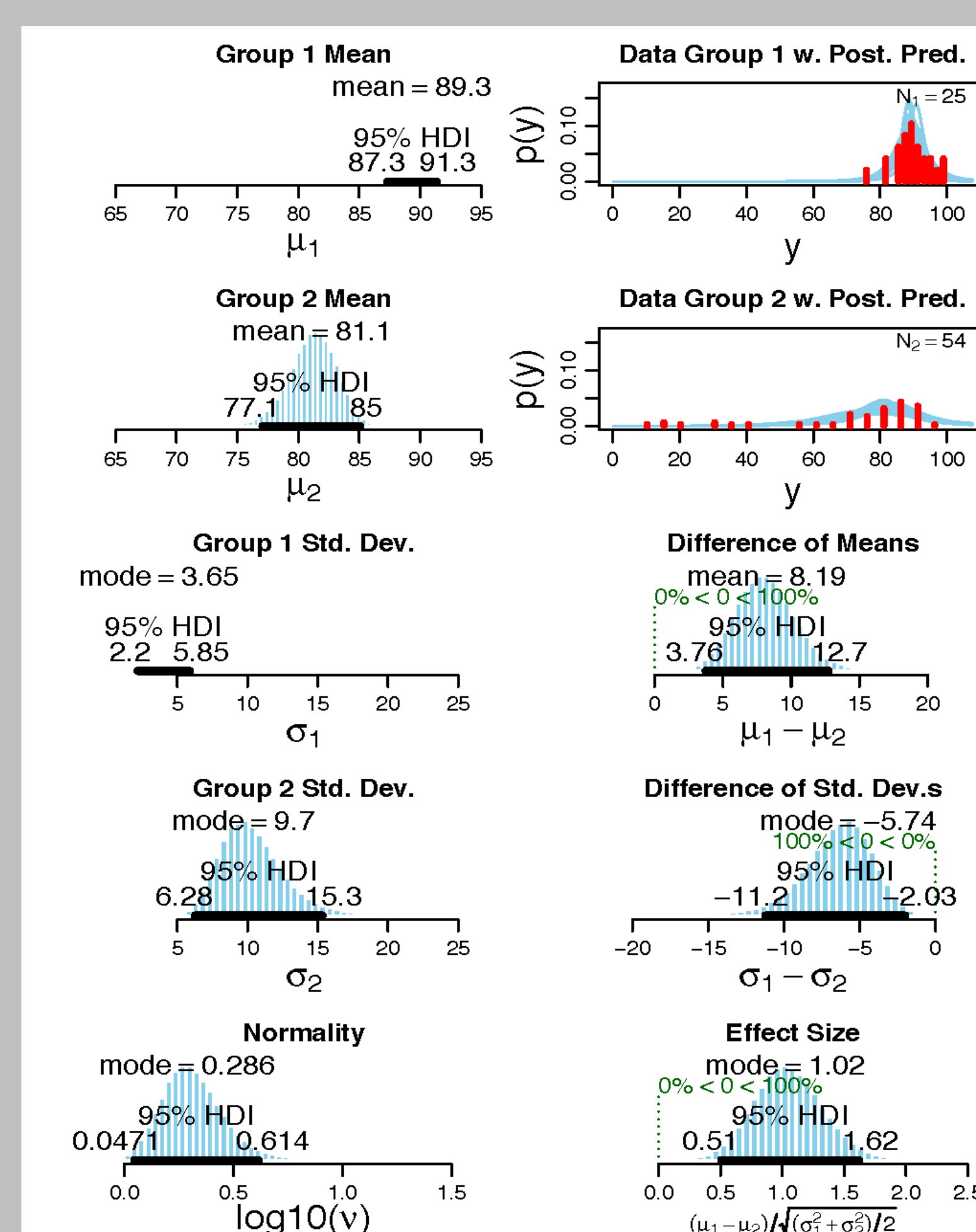


Figure 6. Differences in course performance

## Bayesian estimation of the difference between two groups based on course performance<sup>2</sup>

- Our analysis revealed a credible non-zero difference in course performance between viewers and nonviewers. Viewers earned a higher average grade than nonviewers. The posterior distribution for the difference of means yielded a mean difference of 8.2% with a 95% HDI of 3.8% to 12.7%. The posterior distribution for effect size indicated a mode of 1.02 with a 95% HDI of 0.51 to 1.62 (Figure 6).

## Conclusion

- Our research provides evidence that students exhibit different patterns of accessing prelectures.
- We observed some evidence that students performed better than nonviewers. We did not identify a difference between the groups for all performance measures.
- Since there is evidence for a difference in course performance between viewers and nonviewers, it may be possible to design an early warning system based on the extent to which students view prelectures (or other MLMs).

## Literature Cited

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