Effective use of interactive physics simulations for pre-class assignments

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Introduction
- Pre-reading—brief, focused reading assignments with quizzes—prepare students for active classes
- PhETs are interactive computer simulations that aid physics instruction
- Students learn best with PhETs with question-driven scaffolding

PhET example: Resonance

Research questions
1. Can the use of inquiry-oriented PhET-based pre-class activities (in addition to textbook reading) improve the preparation of students for in-class learning?
   - Does it depend on the order of activities?
2. Can the use of inquiry-oriented PhET-based pre-class activities improve the attitudes of students towards the assignments and material?

Survey results

Time spent on each task
- Students spend marginally more time overall when the PhET assignment is included:
  - Time on Text = 38.2 ± 1.7 min
  - Time on TextThenPhET = 43.4 ± 2.0 min
  - Time on PhETThenText = 42.5 ± 1.8 min
- More students in the PhET conditions said they enjoyed the pre-class assignment (either “Somewhat enjoyed it” or “enjoyed it very much”): 71% of respondents versus 62%.

How much did you enjoy this assignment?
- No enjoyment at all
- Did not enjoy it very much
- Somewhat enjoyed it
- Enjoyed it very much

Student performance in each experimental condition
- Median split; Scores averaged across three topics; Error bars are SEM

Learning results

Study design
- Study conditions: Students complete pre-reading using Textbook only or PhET then Textbook or Textbook then PhET

Start of semester
- Online quiz on all three topics (black-body radiation, masses & springs; resonance)
  - “Prescore”

Trial week for each topic 1-2 days later
- Prescore: identical to pre-test items; Survey items
- Postscore: identical to pre-test items; Survey items
- In class:
  - Clickers: Application questions after instruction
  - “Clickers”

Repeat for 2 other topics, swapping conditions for each group of students

Further analysis is ongoing.

Summary
- Learning occurred during the assignment (from pre-test to post-test)
- Controlling for pre-score and topic, there was no significant effect due to condition (including PhET or not)
- Students spent marginally more time on the assignments with PhETs, and reported enjoying them more.