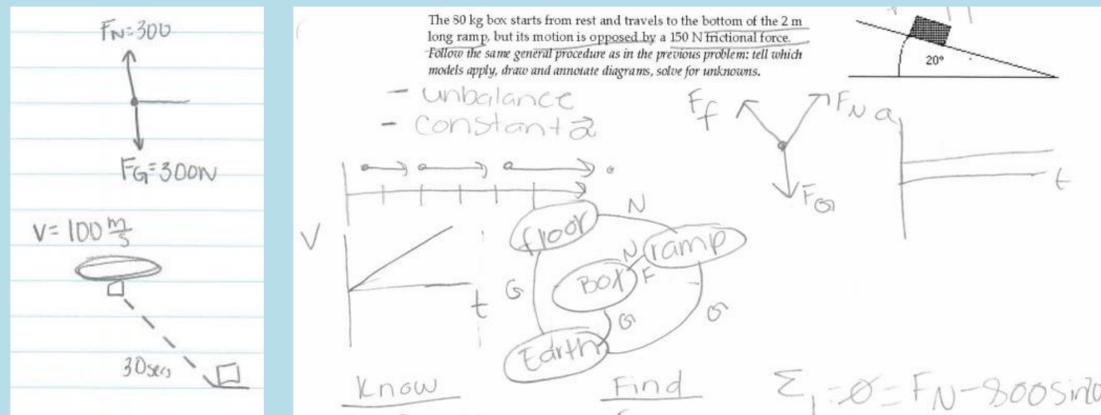


The Impacts of Learning with Multiple Representations in a High School Physics Classroom

Research Focus Questions

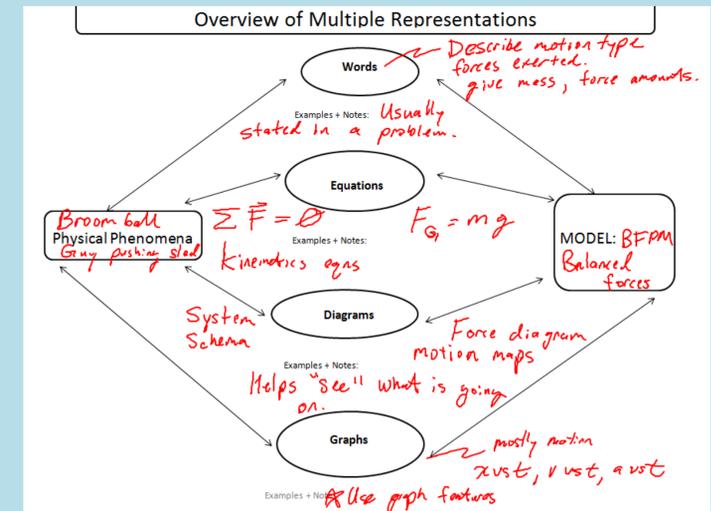
What are the impacts of learning with multiple representations in a physics unit in a high school classroom on: student conceptual understanding, student problem solving, and student attitude?



Introduction and Background

All of physics can be described as representation of the physical world. Physicists are the creators of these representations. I conducted a project with an Honors introductory high school physics class in which students were taught mechanics through a special focus on the creation and appropriate use of multiple representations (Diagrams, Graphs, Equations, Words) This was done to make them better physics thinkers, problem solvers, and improve student attitude. The special focus on multiple representations required students to:

- Convert from one representation to another
- Use more at least four diagrams and/or graphs when problem solving
- Give multiple representations on all quizzes and tests



Student Quotes

"I read the question and I put it in like a real-world situation and I draw a diagram from that and just plug in numbers, then solve."

"diagrams are helpful because they help you come up with an equation and then plug in variables and solve for it"

"diagrams help me see what an object does with forces"

"I sometimes plug numbers into the wrong formulas"

"one of my weaknesses is forgetting what to do with equations"

16. The ball is at the top of a parabolic trajectory.



Data

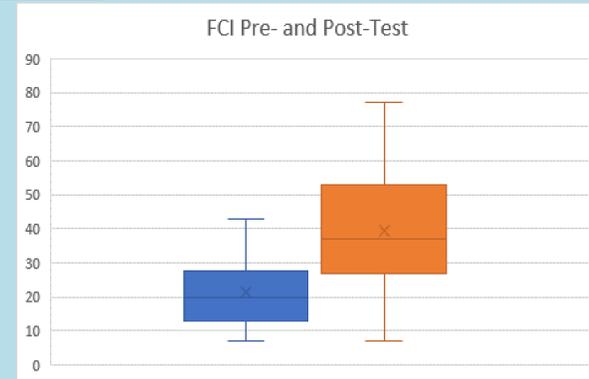


Figure 1. Plots of student scores on Force Concept Inventory, a diagnostic conceptual test in understanding forces (N=54)

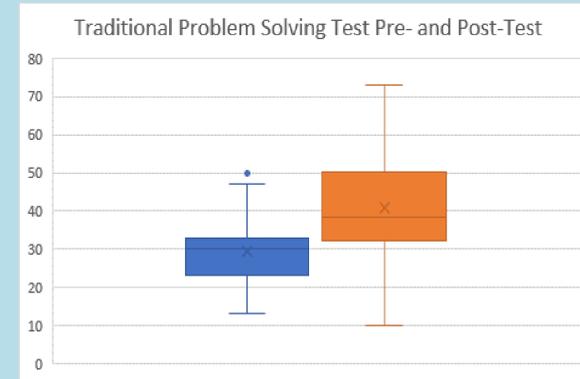


Figure 2. Plots of student scores on a traditional problem solving test (N=54)

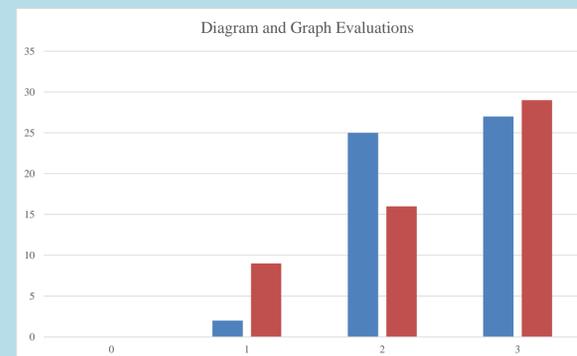


Figure 3. Diagram and Graph Evaluation scores from quizzes before and after the treatment unit (N=54)

Analysis

- Students improved over time in their ability to construct correct and appropriate diagrams and graphs.
- Test and quiz scores correlated more with evaluation of representations when students learned with multiple representations
- Students connected physics to the real world through learning with multiple representations

Value

Students showed a low gain in conceptual understanding through the scores produced in the FCI test. Students also showed a low increase in problem solving ability. Students appreciated that representations helped them in thinking about physics in the real world. Overall value also included:

- Provided teacher with model of professional development for self
- Students learned to think more like expert physicists
- Focus on multiple representations can be one instructional tool used in student centered classrooms

