Making Physics Relevant in Physics 100

CWSEI Year-End Presentation

What CWSEI does for Phys 100

- Funding for dedicated researcher collaborating with instructors
- Consultation and feedback on course elements
- Help with implementation of new ideas
- Learning goals
- Surveys

What's Phys 100

- PHYS 100 provides an algebra-based introduction to the fundamental concepts of physics such as force, energy, thermal physics, radiation and electricity. Requirement for many students that did not take Physics 12.
- Includes laboratory exercises to familiarize students with the physical phenomena and the basic laboratory instruments commonly used to measure them.
- Team: 3 lecturers, lab instructor, 3 mentor TAs, 16 - 20 TAs
- Audience: mainly first year non-physics majors. ~ 50% Science, the remainder Arts, Human kinetics, Forestry etc.
- Majority interested in life sciences, lots of medicine, dentistry and pharmacology hopefuls.
- For many students, this is the only physics course they ever take at university.

Why change Phys 100?

- In the past, students acquired little conceptual knowledge.
- Students believed that doing physics meant applying the right formula, and mostly practiced one problem solving technique: “formula hunting”.
- Students did not see a connection between physics and real life.
- We want our students, as citizens and potential future leaders, to use their scientific knowledge to critically think about real world problems such as transportation and climate change.
- By emphasizing connections to the real-world and their personal lives, we are trying to get students more interested and more engaged in physics.

Changes in Phys 100: Part I (2007)

- Instructors and researchers collaborated to develop explicit course goals.
- The content of the course was adjusted to match the goals and themes.

Content changes:

- After introducing the generalized concept of conservation of energy, we apply it to problems based on home heating, the Earth's energy balance, and climate change.
- Kinematics is discussed in the context of transportation, energy consumption, and fuel efficiency, drawing connections to earlier ideas of energy and environmental impact.
- Basic concepts in electricity such as voltage, current, and resistance are applied to examples of home wiring, transmission lines and electrical energy savings.
- We describe methods of power generation including "green energy" sources.

Changes in Phys 100: Part I (2007)

- The schedule was switched to weekly labs and tutorials (rather than biweekly) to better synchronize the material with lectures.
- The labs were rewritten to more closely follow the scientific method. Several new experiments introduced.
- New tutorials consist of groups of 4 working on a single, context-rich problem with group tests every 3 weeks.
- For a final project, student groups researched and evaluated a research question such as the impact of an environmental action (for example paper vs. plastic bags, reduced a/c in the workplace, electric dryers vs. hanging to dry clothes) involving basic physics. These were 10 min. Power Point presentations marked by lecturers and TAs.

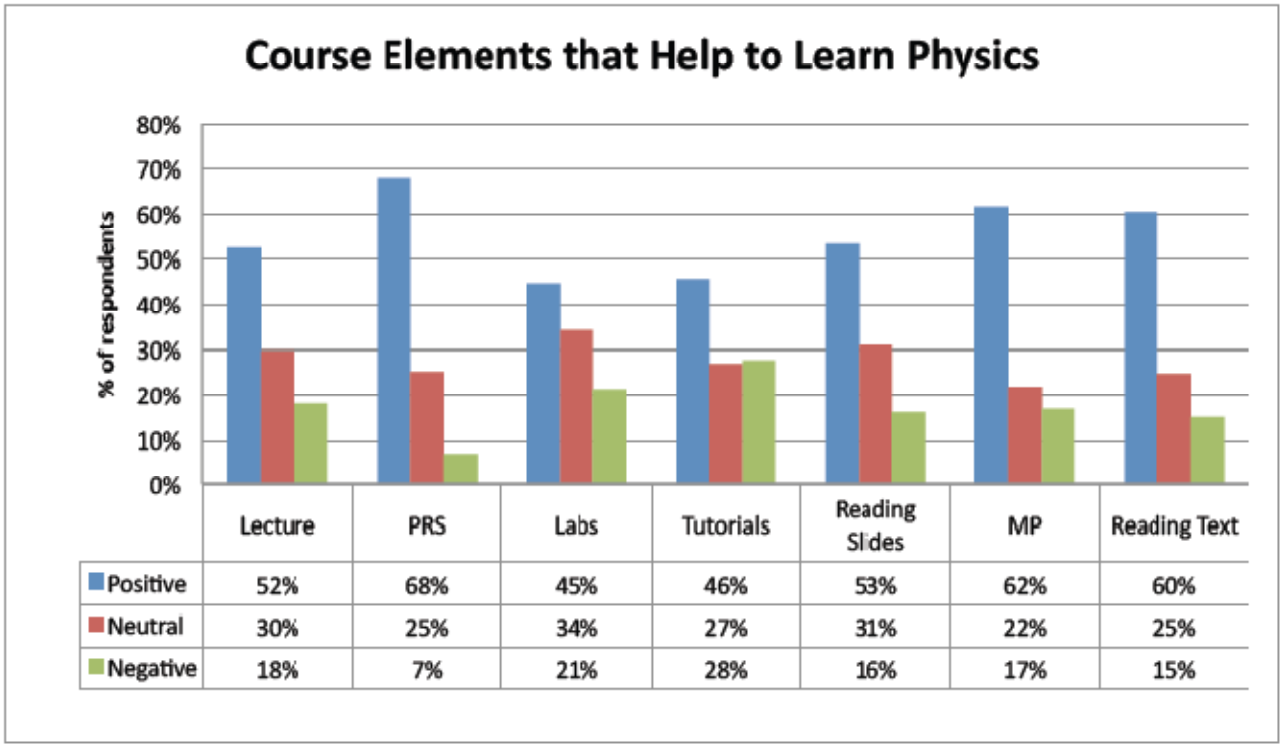
Changes in Phys 100: Part II (2008)

- More changes were introduced in 2008 following the realization (CLASS, student interviews) that 2007 changes did not significantly change students attitudes and beliefs. Apparently, the “Real World” did not have the same meaning for instructors and for students.
- Introduced more examples connected to the students personal lives, rather than social issues
- Simplified the discussion of climate change and radiation.
- Eliminating unused information from course materials and using a custom textbook
- Refine lab instructions to emphasize application of results to physics in the real world.
- Improve context-rich tutorial problems to further encourage productive group interactions.

Final Project

- To encourage students to develop real world connections, student groups research and present on an application of physics to a question or issue
  - *Example: If 12 or fewer people take a commuter train it would be better for the environment if they all drove*
- In 2007 presentations were commonly heavy on presentation, light on physics.
- Peer review session and heavier weighting on physics models added in 2008 to encourage deeper analysis
- Rubrics and Peer Review will be refined in 2009 to provide more structure and feedback for students' analyses.
- Impact of Final Project on student attitudes and problem solving skills is subject of ongoing research

Student Feedback on Course Elements, 2008

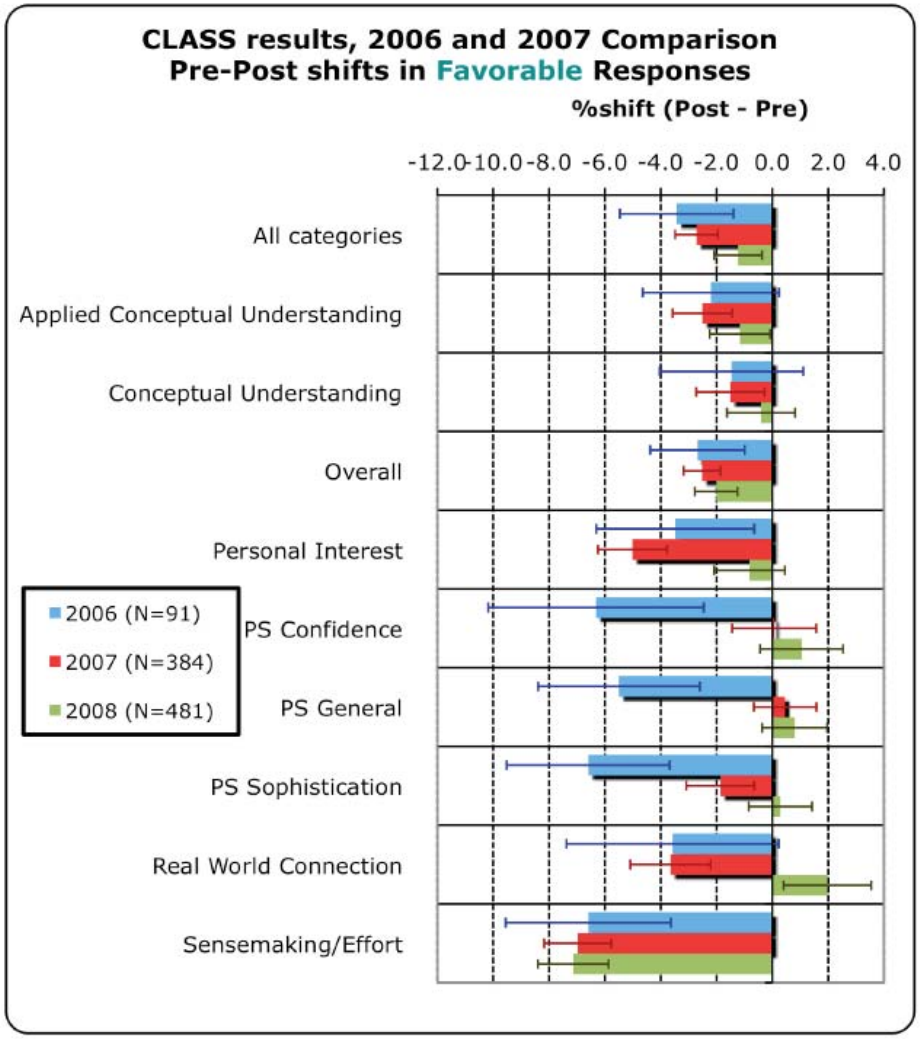


	Lecture	PRS	Labs	Tutorials	Reading Slides	MP	Reading Text
Positive	52%	68%	45%	46%	53%	62%	60%
Neutral	30%	25%	34%	27%	31%	22%	25%
Negative	18%	7%	21%	28%	16%	17%	15%

- Students report PRS most helpful with learning physics
- Tutorials were most difficult part of the course

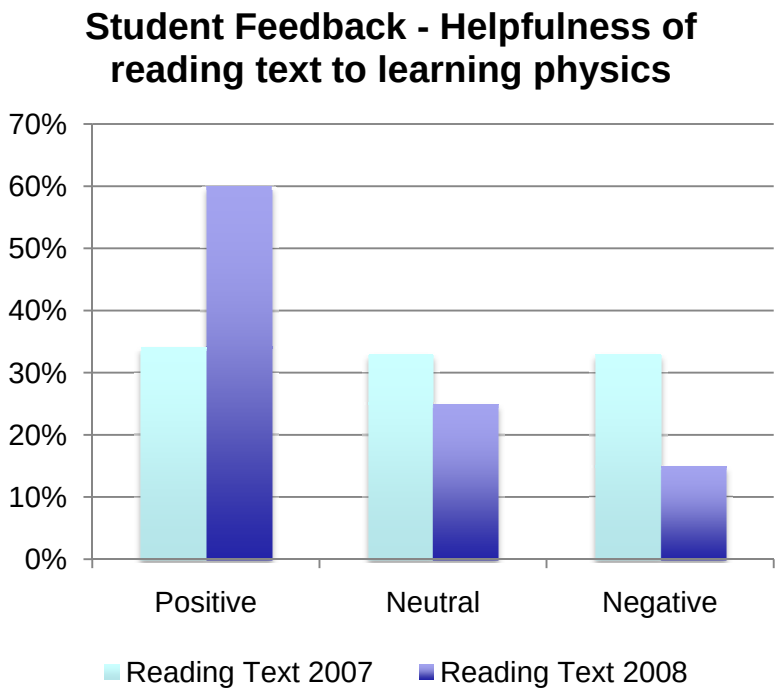
Attitude Survey Results

- CLASS student attitudes survey conducted in ‘06, ‘07, ’08
- This survey measures student attitudes in 8 categories
- Real-World Connection category showed no improvement in 2007, but did increase significantly ir 2008



Improvements in Textbook

- Text in 2007 consisted of calculus-based Knight with supplemental online chapters
- In 2008 was changed to selected chapters of algebra-based Knight with printed supplements, bound in single coursebook



Planned for 2009

- Fine tuning of labs, tutorials, custom textbook.
- Refinement of Final Project.
- More examples based in biology and energy consumption that connect to personal experience of students (TLEF project).
- Possible introduction of reading assignments that also integrate pre-lab and pre-tutorial exercises.
- Use of WebCT Vista discussions for getting weekly feedback from students about conceptual difficulties (following reading assignments) and for homework help (replacing TA resource centre help sessions).

An Example Used in Phys 100

Which question style engages the students more?

- *Context-Rich Question:* You are helping a friend design a car for an upcoming roller derby race. This is a race where the driver pushes a small cart and then jumps on and completes the race powered only by gravity. No pushing or other propulsion is allowed after the initial start.

  The race will be conducted down a hill 50 m high along the 700 m long road. Your friend is a pretty good runner, and figures that he can accelerate the cart up to 18 km/h before jumping in at the top of the hill. If your friend weighs 60 kg and the cart weighs 25 kg, how fast will the cart be moving once it hits the bottom of the hill? (Be sure to state and justify any assumptions you make to solve this problem)

  To increase the speed of the cart, should you make it lighter or heavier or it does not matter?

- *Textbook Style Question:* An 85 kg block with an initial speed of 18 km/h slides down a frictionless inclined plane that is 50 m high and 700 m long. What's the speed of the block at the bottom of the plane? How will the speed change if you used a 60 kg block instead?

Physics 100 Personnel

- *Instructors: Andrzej Kotlicki, Georg Rieger, Fei Zhou*
- *CWSEI Researcher: Sandy Martinuk*
- *Mentor TAs: Sandy Martinuk, Joss Ives, Mya Warren, Tyler Hughes, and Melanie Gendre*
- *And a lot of dedicated and talented TAs!*