Strengthening Problem Solving & Laboratory Skills in Physics 211 & 216

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Course Structure:

- Physics 211 & 216 are designed to introduce students to the concepts of kinematics, Newton's Laws, gravity and thermodynamics.
- Physics 211 is the "lecture" component of the class, while Physics 216 is the co-requisite lab component.

Class Size:

Approximately 160 Students

Documenting Student Learning:

- We have developed a simple rubric for faculty to use to document student learning
- Faculty use a minimum of 10 questions to assess achievement of KU Core learning outcomes.
- A database of "department approved/tested" questions ad records of past student results are kept on Blackboard.
- Student results are tabulated and reported

Excellent > 89%	Very Good 80% to 89%	Good 70% to 79%	Satisfactory 60% to 69%	Unsatisfactory < 60%
27	47	59	18	4

- Form includes space for faculty discussion of results and suggestions for changes.
- We look forward to more detailed analysis once more data has been collected. This could tell us whether some questions more discriminating than others

Moving Forward:

- From a professors' point of view the course is now more fun to teach because I spend more time actually working with students.
- The logistical issues have also been greatly simplified by the use of course shells on Blackboard.
- Student learning, satisfaction and retention seem higher.
- Next step will be longitudinal tracking of students performance down stream.

Flipped Format in Physics 211:

Before Class

- Students are responsible for familiarizing themselves with the material before class through assigned readings and videos.
- For each concept there is also an example problem worked out on video and a few blackboard questions to test the reading.

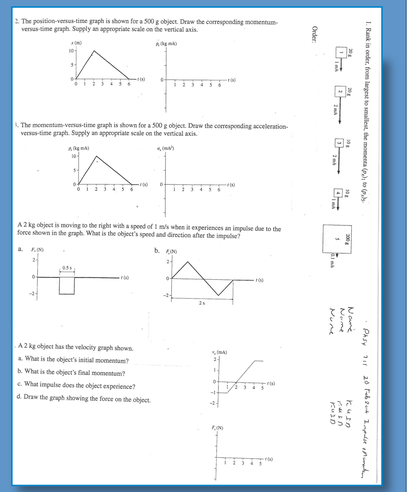
Using Class Time for Deeper Engagement

Undergraduate TA guiding a small group

Group Work:
Most of class time is spent working on group problems. Faculty and undergraduate Tas help guide the groups.

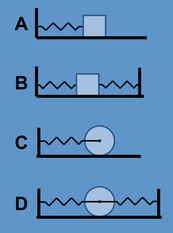
Engaging Discussion:
To keep the discussion moving, the instructor will take work from a random group and share it with the whole class on the doc cam. Students then vote about whether they think the answers are correct.

Developing Critical Thinking:
A suite of critical thinking questions have been developed to push the students to move beyond pattern matching.



Example of a small group worksheet

Rank the magnitude of the angular frequency of the following harmonic oscillators. The object in C and D is a cylinder which rolls without slipping as it oscillates. All springs are identical and the mass of each oscillating object is the same.



A. $\omega_A > \omega_B > \omega_C > \omega_D$
B. $\omega_C > \omega_A = \omega_D > \omega_B$
C. $\omega_A = \omega_D > \omega_C > \omega_B$
D. $\omega_B > \omega_A = \omega_D > \omega_C$
E. $\omega_B > \omega_D > \omega_A > \omega_C$

After Class

Students get extra practice on problem solving with online homework. The undergraduate TAs a lso host problem sessions in the libraries. The TAs are quite strict about not solving problems for the students.

Making Labs More Meaningful in Physics 216:

Before Lab

- Students have assigned reading and videos as well as a quiz.

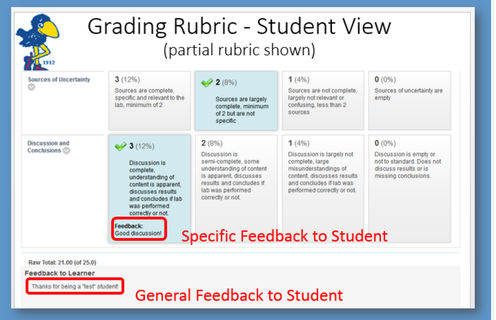
- The videos are very popular with the students and GTAS.

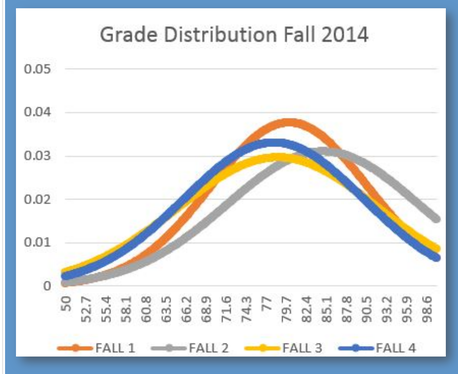
During Lab

- The pre-lab work means that the students spend more time on "twindling" with the equipment and re-checking their measurements.
- These are essential first skills of an experimental scientist.

Assessing Labs

- Student lab reports are graded using a rubric on Blackboard. This has decreased the time GTAs spend grading & provided the head TA with a way to give GTAs feedback on the grading.





- The grading of the labs is not only faster and more useful to the students but also more uniform.
- We no longer need to "renormalize" each TAs grades at the end of the semester, which means that students have a much better idea of how they are doing during throughout the semester.