Just In Time Teaching:

More fun than a professor should be allowed to have?

(Mats Selen, UIUC Department of Physics)

- Why I got into it.
- Why I'll never do it any other way again.
- Why you should try it too!
Overview of the UICU calculus-based introductory physics sequence

- Physics 111 (4 hrs, mechanics)
- Physics 112 (4 hrs, E&M)
- Physics 113 (2 hrs, thermo/stat-mech)
- Physics 114 (2 hrs, waves/quantum)

- Total enrollment of about 3500
- Mostly Engineering & Physics students

Most freshmen start here

In Phase
Out of Phase

Spring
900 in 111
350 in 112
550 in 113/114

Fall
450 in 111
750 in 112
450 in 113/114

Summer
Overview of the UICU algebra-based introductory physics sequence

- Physics 101 (5 hrs, mechanics, heat, fluids, waves)
- Physics 102 (5 hrs, E&M, Light, Atoms, Relativity)

- Total enrollment of about 1100
- Mostly pre-med & life-science students
Overview: How it used to work:

- **Tradition, Tradition, Tradition**
  - Lecturer “owns” the course and is free to “reinvent the flat tire” every semester.
  - Discussion TAs pretty much on their own.
  - Labs intellectually disconnected from rest of course.
  - Typically only quantitative problems on exams.

- **RESULTS: NOBODY IS HAPPY!!**
  - Lecturer dislikes it since it’s a monster teaching assignment.
  - Students dislike it because they see the lecturer dislikes it and because the organization is often “uneven” at best.
Overview: How we do it now:

- Integrate all aspects of a course using active learning methods in a team teaching environment.

  ➔ Typically 3 faculty share the load:
    - Lecturer (lectures, ACTs, preflights, exams).
    - Discussion Director (TA training, quizzes, exams).
    - Lab Director (TA training, web homework, exams).

  ➔ Course administration is shared responsibility:
    - Faculty meet at least once a week with each-other and with their TA’s to plan the campaign.
    - Overall co-ordination is very tight (web helps this).
    - Everybody works on creating exams.
Course material changes adiabatically:
  » Recycled & tuned from semester to semester.
  » People don’t need to re-invent the whole stew, but can focus on the spices!

Advantages of this approach:

Existing (evolving) infrastructure lowers the bar for participation.
  » This is now seen as a reasonable teaching load.
  » Most of our new junior faculty start teaching in these courses (i.e. not a heavy assignment).

Pain & Gain are shared
  » No burnout & No heroes.
  » Makes it possible to keep quality high and material consistent even though instructors are changing.
**Feedback**
(are things better now?)

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**THE OLD**
Spring 95
Total Physics TAs = 77
# “Excellent” = 15

\[19 \pm 5\%\]

**THE NEW**
Spring 01
Total Physics TAs = 75
# “Excellent” = 58

\[77 \pm 6\%\]
Details of some key components:

WEB-centric organization

Peer instruction in Discussion & Lab sections

ACTs & Preflights in Lecture

Homework & Interactive Examples

Exams
Pre-Flights (Just In Time Teaching)

- Students are asked to answer a set of conceptual questions (on the Web) prior to every lecture (and discussion, and lab).

- The main structure is:
  - Students read about material in text.
  - Students answer pre-flight questions on material prior to lecture.
    - Physics 101 PF's due at 6am, lecture starts at 1pm.
    - Graded on participation, not correctness.
  - Instructor uses pre-flight responses to guide lecture preparation.
    - Stress difficult material
  - Pre-flights are reviewed during lecture, often presented again as ACTs, and often capped off with a demo.

- With careful preparation, the pre-flights can form the “backbone” of the lecture.
Lecture 2 Preflight

(6 questions)

If you change any of your answers, be sure to click on Store My Answers at the bottom of this page before you leave. The deadline for storing your answers is 0600 on 01/24/2001.

1) If the average velocity of a car during a trip along a straight road is positive, is it possible for the instantaneous velocity at some time during the trip to be negative?
   - Yes  - No

2) Briefly justify your answer:
   
3) If the velocity of some object is not zero, can its acceleration ever be zero?
   - Yes  - No

4) Briefly justify your answer:
   
5) Is it possible for an object to have a positive velocity at the same time as it has a negative acceleration?
   - Yes  - No

6) Briefly justify your answer:
   
---

What I typed in a simple text file:

```
title "Lecture 2 Preflight";

question "If the average velocity of a car during a trip along a straight road is positive, is it possible for the instantaneous velocity at some time during the trip to be negative?";
   right "Yes";
   wrong "No";
   radioh;
   question "Briefly justify your answer:";
   textarea;

question "If the velocity of some object is not zero, can its acceleration ever be zero?";
   right "Yes";
   wrong "No";
   radioh;
   question "Briefly justify your answer:";
   textarea;

question "Is it possible for an object to have a positive velocity at the same time as it has a negative acceleration?";
   right "Yes";
   wrong "No";
   radioh;
   question "Briefly justify your answer:";
   textarea;
```
The instructors interface to the student responses (also on web):

phys101/spring00 lecture preflight responses

Pick a lecture preflight from this list: G2

Mark the number(s) of the answer(s) you want displayed: [optional]
If you don't mark any, the answers to all of the questions will be displayed.


Pick section(s): G1 (e-potter) [required]

Choose the students to include: □ those who responded  □ those who did not respond

Set filter if needed: (samples)
Include only students for whom:

Specify the student identifier(s) to be displayed: □ name and netid  □ section  □ special id

Then click on this button: Responses

Or click on this one: Percentages

Statistics:

QUESTION 1 (249 responses)

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<th>percentage</th>
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<td>183</td>
<td>73%</td>
</tr>
<tr>
<td>2</td>
<td>66</td>
<td>27%</td>
</tr>
</tbody>
</table>

Free response:

Afsharzadah Majid (afsharza)  T2 F3X lecture preflight 02
2: It could be possible that in a short amount of time the velocity decreased yet for the whole time the average can be positive.

Ahn Bonnie Se-Jeong (hsahnu)  J2 L2X lecture preflight 02
2: during the course of the trip, the car could have traveled in both positive and negative directions. The positive average velocity just indicates that net displacement of the car was positive.

Akbar Imran Shaan (akbar)  R2 F3X lecture preflight 02
2: the overall velocity can be positive even though the car might have gone in the negative direction with velocity

Alfano Lisa Marie (lalfo)  G1 L1X lecture preflight 02
2: An average velocity is just that, an average of the total instantaneous velocities. Somewhere in the average, an instantaneous velocity can be negative since the average does not account for these variations.

Ambler Steven Benton (sambler)  T2 A1X lecture preflight 02
2: instantaneous is the velocity at a single point in time. Since the car only travels in one direction, it will always be positive.
If the average velocity of a car during a trip along a straight road is positive, is it possible for the instantaneous velocity at some time during the trip to be negative?

1 - Yes \(\text{correct}\)
2 - No

As long as the net distance traveled over the given time was positive, the average velocity will be positive—regardless of whether the car went in reverse at any point during that time.

I could have forgotten something at home and had to turn around, but eventually I reached my destination away from my starting pt.

Velocity cannot be negative in reality.
Two identical boxes, each having a weight $W$, are tied to the ends of a string hung over a pulley (see picture). What is the tension $T$ in the string? [see text 4.10]

1. $T=0$
2. $T=W$  \textbf{correct}
3. $T=2W$

![Graph showing the percentage of correct answers]

- 0%  20%  40%  60%
- 23%  33%  44%
Two identical boxes, each having a weight $W$, are tied to the ends of a string hung over a pulley (see picture). What is the tension $T$ in the string? [see text 4.10]

1. $T=0$
2. $T=W$
3. $T=2W$

Due to Newton's second and third laws, the rope itself is massless, so any force transmitted across it is done so without the diminishing of any magnitude. As each box has an equal weight, the tension $T$ must be zero, as each box's force cancels the other's out.

The force applied to the rope is transmitted to the other side. This example would be just like a person hoisting up a box, pulling on the rope with a force of $W$. In this case, the tension would just be $W$.

The string has the tension of two weights.
Driving your car on I-57 you encounter a bug which (sadly) splatters on your windshield. During the collision between the car and the bug:

1. The force exerted by the car on the bug is BIGGER than the force exerted by the bug on the car.

2. The force exerted by the car on the bug is SMALLER than the force exerted by the bug on the car.

3. The force exerted by the car on the bug is THE SAME AS than the force exerted by the bug on the car. **correct**

The car has greater mass. I think force is something like a product of mass and change in speed.

The car had higher speed.

For every action there is an equal and opposite reaction. But a bug can't withstand the same amount of force as a windshield, so it squishes.
This is a great (but incorrect) response:

I seem to remember a phrase stating that for every force, there is an equal and opposite force. For example, if I push against the wall, there is an equal and opposite force pushing back. But, if I push against a door and it closes, I have to reason that the opposite force cannot be equal because the door is moving. I guess I feel that way about the bug.

There is a subtle flaw in this otherwise good argument. 

Catalyst for a very productive discussion!
Unintended Benefit: Class Evaluation

7) I have noticed that not many people are coming to office hours, and I am concerned that you are not taking advantage of the opportunities to ask questions in an informal setting. I would like to take a survey to see how many of you come regularly.

Which of these describes the frequency with which you go to office hours?
- I go at least once per week.
- I come from time to time and not as often as once per week.
- I come infrequently or not at all.

8) As usual I’m having a great time teaching this class, however it’s your opinion that matters. If you have any comments (good or bad) about any part of the class so far, please tell me.

QUESTION 7 (281 responses)

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<td>10</td>
<td>4 %</td>
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<tr>
<td>2</td>
<td>28</td>
<td>10 %</td>
</tr>
<tr>
<td>3</td>
<td>243</td>
<td>86 %</td>
</tr>
</tbody>
</table>
Students are usually very candid in their responses… they will gladly tell you what they like and what they don’t like

lecture preflight 07
7: 3
8: So far, this class is not as bad as I thought it would be. I am really impressed with several things about this course. First, compared to the general chemistry and bio sequences, this class is extremely well organized. Second, everyone in the department is so friendly, enthusiastic, approachable and willing to help. It makes things so much easier. I am a little concerned about my personal performance, but I know that plenty of help is available.

lecture preflight 07
7: 3
8: Class is fine, when things get tougher for me I will have no qualms about going to office hours.

lecture preflight 07
7: 1
8: I go to my TA’s office hours. i have been to the room on the 2nd floor of loomis 3 times to ask questions about homework.

lecture preflight 07
7: 3
8: I don't think lectures help much because they're basically a review of the preflights.

lecture preflight 07
7: 3
8: the hints on the homework problems are absolutely ridiculous! Oh yeah, I can figure out that problem now that the hint I was given says to look in the book. That was sarcasm. get some better example problems or something because these homework hints are for the birds.

lecture preflight 07
7: 3
8: I think the lectures are quite entertaining however I don't like the way the quizzes don't match up with what we talk about in lecture!!!!!!!! I have discussion on Wed and the stuff I am quizzed on is sometimes stuff I have just done in class that same Wed. Also, Its good to have teachers that want our opinion.
Can this be used successfully by other types of classes??

- We (physics) use JITT in big & small, intro & advanced courses.
  ➔ PHYCS 101, 102, 112, 225, 326, 303 etc.

- We gladly host courses from other Departments / Universities / Colleges who want to use our tools:
  ➔ Example: PSYCH 100 this semester (Missa Murry Eaton)

- Everyone who tries this likes it!
Mats and Denny:

Thank you a million times over, Mats for presenting this program in such a way that I knew immediately I wanted to use it, and Denny for setting everything up and helping me get started, and both of you for being so open to hosting the program for me.

My first preflight has been available for 3.5 hours, and I already have respondents with really insightful answers. This is awesome!

I also wanted you both to know that I am planning to propose a poster on my experience with JITT in my classroom this semester to the Midwestern Psychological Association meeting to be held in May in Chicago.

Thanks again! Missa

From one of her Psych-100 students earlier this week:

Oh, and I just wanted to say-I really do like those pre-flight exercises. It really helped me to review what I just read and actually focus on it. Just thought you might want to know that :) Thanks again.

Sincerely,

-------- end of forwarded message --------
Simple setup on our NT server:
Text (& pictures) for PF 2 in here

Notice: Lots of folks use our web-based grade-book:
Suppose you float a large ice-cube in a glass of water, and that after you place the ice in the glass the level of the water is at the very brim. When the ice melts, the level of the water in the glass will:

1. Go up, causing the water to spill out of the glass.
2. Go down.
3. Stay the same.  **CORRECT**
Nice Tools:

We can “filter” on responses based on other questions!!
Lecture 20, Preflight 2

Which weighs more:
1. A large bathtub filled to the brim with water.
2. A large bathtub filled to the brim with water with a battle-ship floating in it.
3. They will weigh the same. **CORRECT**

Students who got Preflight #1 right.

Students who got Preflight #1 wrong

Tub of water

Tub of water + ship
Students have fun with answers...

Shown is a yummy doughnut. Where would you expect the center of mass of this breakfast of champions to be located? (Explain your reasoning Homer).

In the center. Assuming a perfectly symmetrical donut, all the mass is equidistant from the center. Until someone takes a bite. (Doh)

you're not getting my answer unless i get sprinkles.....suckers ! unfortunately, i think the center of mass of this perfectly symmetrical donut would be the center of the donut which does not seem to exist; so, i'll just say homer ate it.

I think it would be in a the middle of the dough in a circular pattern. Kind of like the onion in an onion ring. UMMMMM..... Onion rings!!!!