

Optimizing Students' Preparation for Class

Just-in-Time Teaching (JiTT)

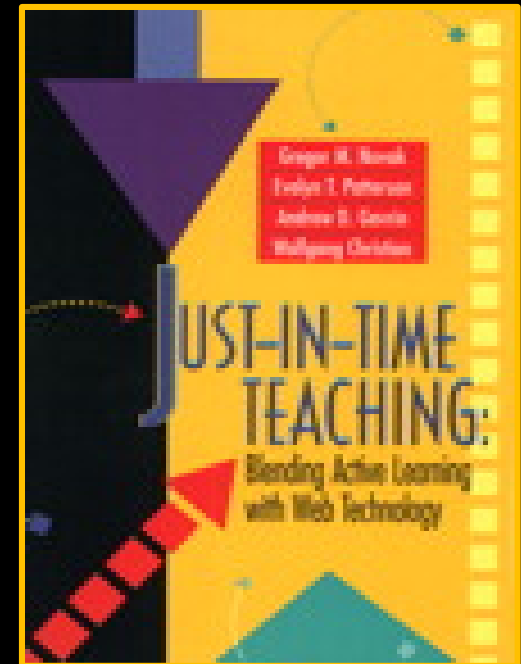
Mario Belloni (Davidson College)

<https://www.phy.davidson.edu/FacHome/mjb/nfw/jitt.html>

Optimizing Students' Preparation for Class

**Just-in-Time Teaching:
Blending Active Learning
with Web Technology**

1999



Introductory Comments

- You are learning a lot of techniques, and hopefully very excited about using them. You should not, however, strive to use them all in every class. Pick 1-2 techniques that you think fits your style, your students, and your school the best.
- Whatever you do, “As you enter a classroom ask yourself this question: ‘If there were no students in the room, could I do what I am planning to do?’

If your answer to this question is yes, don't do it.”

---Gen. Cubero, USAFA

Outline

- Introduction
- Implementation
- Final thoughts
- Getting student great evaluations

Goals

- Give you a JiTT “experience”
- Give you a sense of why JiTT is effective
- Enable you to put JiTT into practice
- Introduce you to some resources
- Prepare for the “Going Deeper” session

The (original) settings

- IUPUI: Large, public, urban university
 - 30,000 students, almost 100% live off campus
 - Most work > 25 hours/week
- US Air Force Academy: Military College
 - All students take physics, even history majors
 - All play sports, train for military
- Davidson College: Small liberal arts college
 - Highly selective
 - Small classes

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What is JiTT?

- Basing class plans on student responses to pre-class activities
- A homework or quiz due shortly before class which has influence on the teaching in class.
- JiTT is a way to enhance learning experience. Students will be more prepared for the class by doing pre-class assignments. Faculty can use the results to adjust class plans so that students can learn better and engage more in class.
- JiTT utilizes pre-class assignments to both encourage students to do outside-of-class study and help the instructor gauge how well the students understand the material, so they can adjust the lesson plan accordingly.
- Tailoring in class activities based on students' responses to pre-class activities
- Techniques to encourage student preparation before class, get feedback about topics students find difficult, and adjust class to address these issues.
- Using pre-class checks to determine which topics to emphasize during lecture, as well as steer conversation about topics from a student-motivated perspective.
- JiTT is a pedagogical strategy that involves students taking time outside of class to prepare for the upcoming session. Often it involves the students asking questions involving concepts that will be involved in the upcoming class. In this way, it is similar to a reading quiz, however, JiTT work is always completed before the start of the class. This has the benefit of not only saving class time, but also allows the instructor to review student submissions before the start of the class period and adjust the planned in-class activities accordingly.

Which is more important?

- Students will be more prepared for the class by doing pre-class assignments.

or

- Faculty can use the results to adjust class plans so that students can learn better and engage more in class.

Digression

- JiTT described in your words
- “preview” of important concepts
- Jargon already familiar (JiTT, Warmup)
- Big idea (connect class to HW) already present

Lightning summary

- **Use Warmup exercises to**
 - Motivate and improve preparation
 - Help faculty focus class
- **WarmUp = Online,**
 - Due few hours before class
 - A few open-ended conceptual questions
 - Cover that day's material
 - Provide “conversation starters”

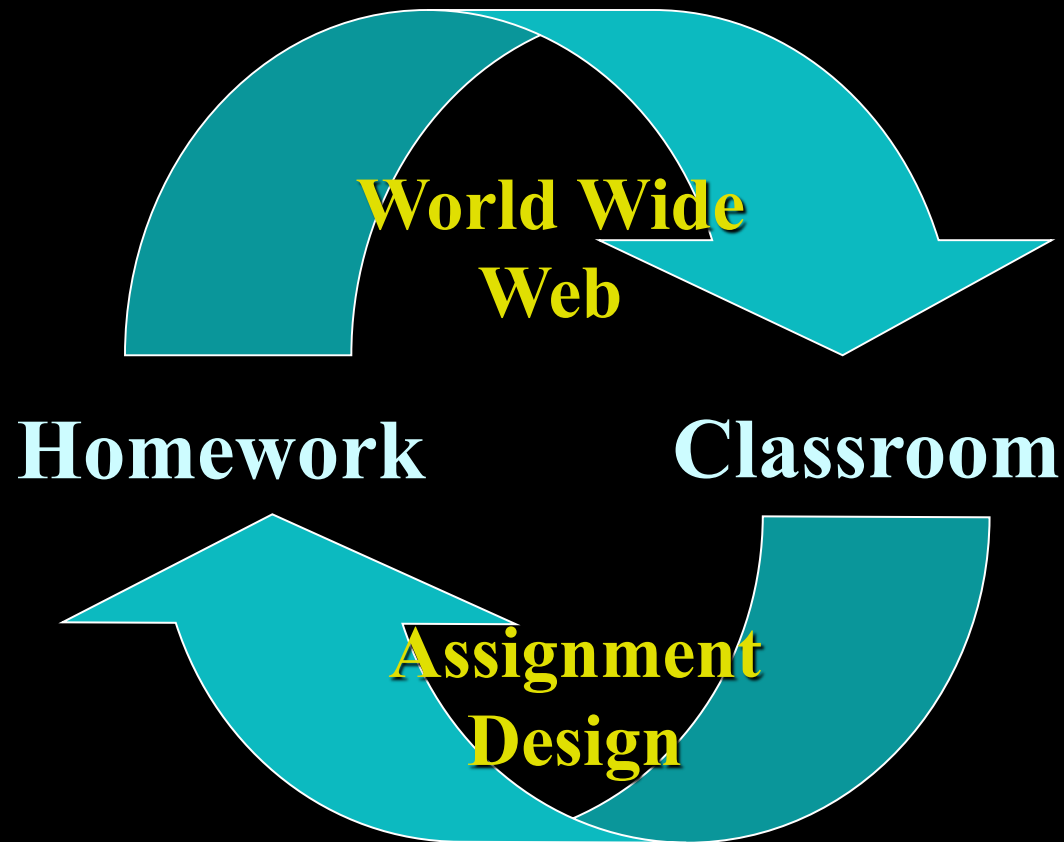
What is JiTT?

- fusion of web-based learning with in-class learning
- JiTT is a technique derived from the fundamental idea that **improving communication** between students and teachers, especially with low latency and meaningful feedback, will improve learning.
- JiTT is a means to assess student understanding **before** class begins in order to **focus classroom time on content that the students struggled with**, making class attendance more meaningful and worthwhile for the students. JiTT also **encourages more faculty-student interaction**, which has been shown to improve student learning. JiTT can take many different forms, but the idea of any pre-class exercise is to **give students a chance to think about the material before they come to class.**

What is JiTT?

- JiTT is a mechanism that helps to 'invert' a classroom by asking students to complete a web-based assignment before lecture begins, allowing the instructor to use lecture time reacting to student performance on the assignment. JiTT appears to have the benefits of engaging students on their own time, providing the instructor with feedback about misconceptions and 'already mastered' concepts, and 'personalizing' the lecture time.
- Let students do some warm-up exercise before class, the feedback to used to make classroom learning more efficient
- JiTT is about using classroom time not to lecture but to addressing the major issues confronted by students thereby making them a more involved participants in the class.

Just-in-Time Teaching (JiTT)



Example

- *Question: Is it possible to add heat to an ideal gas without changing its temperature? If it is possible, please explain how it is done.*
 - “It is not possible because the internal energy of an ideal gas only depends on the temperature.... the internal energy will increase when the temperature rises....”
 - “If you add heat to a system while the system is doing the corresponding amount of work, the temperature will not change.”
 - “It is possible to add heat to an ideal gas without it changing its temperature by the gas receiving the heat, and the atoms of that gas getting excited enough to disperse that heat as fast as they receive it...”

More Examples

- In a few sentences, explain what an "impulse" is, and how it can be calculated.
- A Ford Mustang weighs about 3500 pounds and can accelerate from 0-60 MPH in about 5 seconds. What force is responsible for this acceleration? What is its approximate magnitude?
- In a sentence or two, please describe the difference between "gauge pressure" and "absolute pressure? When would you want to use each?

Impulse responses

- impulse is the change in momentum over time. it can be calculated by integrating force as a function of time
- ...its the force integrated over the time period or the change in momentum in that time period.
- An impulse is a large amount of force that acts on an object of a short amount of time.
- An impulse is the moment at which two objects initially collide and exert enormous force upon each other.

What does the book say?

IMPULSE

When two objects collide, they usually exert very large forces on each other for a very brief time. The force exerted by a baseball bat on a ball, for example, may be several thousand times the weight of the ball, but this enormous force is exerted for only a millisecond or so. Such forces are sometimes called *impulsive forces*....

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What makes a good Warmup?

- A good warm-up exercise should reveal how well students understand the subject of the lesson. They should not just require students to regurgitate facts but require them to demonstrate that they have thought critically about the material.
- Something open-ended and thought provoking. Perhaps something that is typically confusing for students.
- There are several types of warm-up exercises that I use in my class, but my favorites are ones that poke at students' previously held beliefs/intuitions (which are generally wrong). In this way, the student is immediately confronted with their poor intuition. I find these types of questions help to peak the students' interests.

What makes a good Warmup?

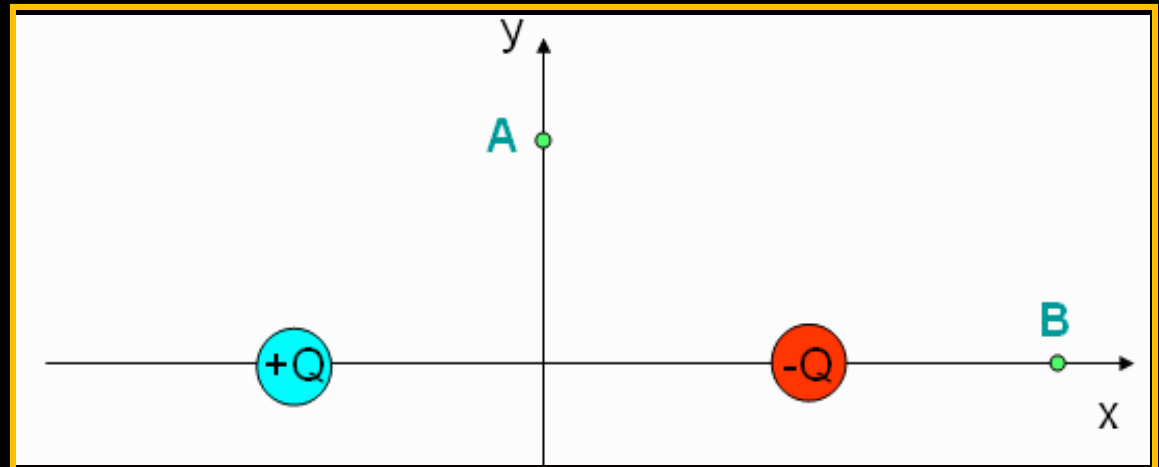
- Encouraging curiosity, providing feedback to teacher before class
- It relates directly to the covered topic and asks for concepts rather than full calculations.
- A good "warm-up exercise" should be able to prompt the students to think about the topic to be covered in class and subsequently answer the question to the best of their ability. It is designed to develop their own independent way of thinking which could come in handy especially when they are to solve problems in real-world scenarios in a job.
- A good warm-up exercise is one that is solvable in a short length of time but gets at a fundamental concept.
- A good warm-up exercise should be thought provoking, on a topic that a student can understand well (from experience), as well as open-ended. The open-endedness will enable students to explore different directions which in turn will enable them to understand the topic better.

Example

1. Two equal, but opposite charges are placed on the x axis. The positive charge is placed at to the left of the origin and the negative charge is placed to the right, as shown in the figure. What is the direction of the electric field at point A?

- a) up b) down c) left d) right e) zero

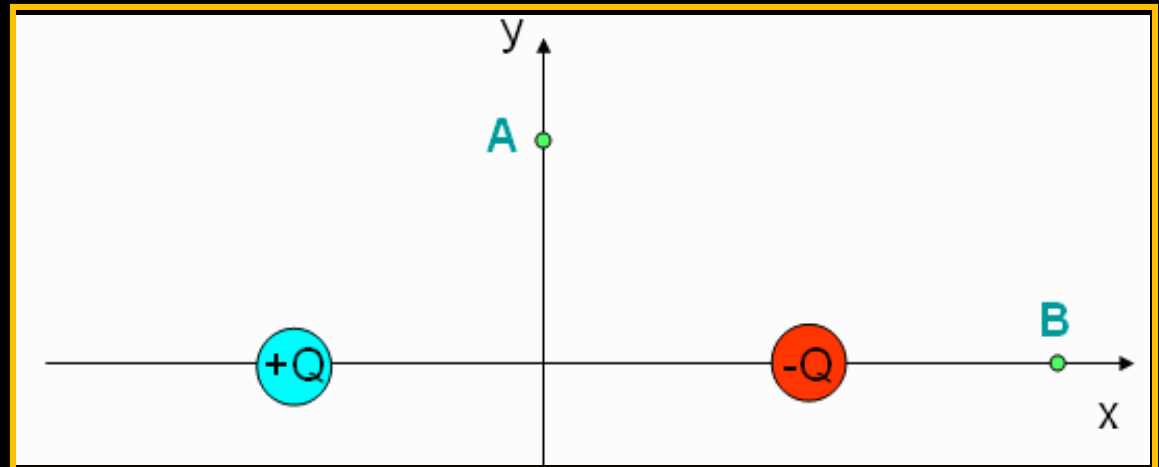
2. Explain your reasoning



Example

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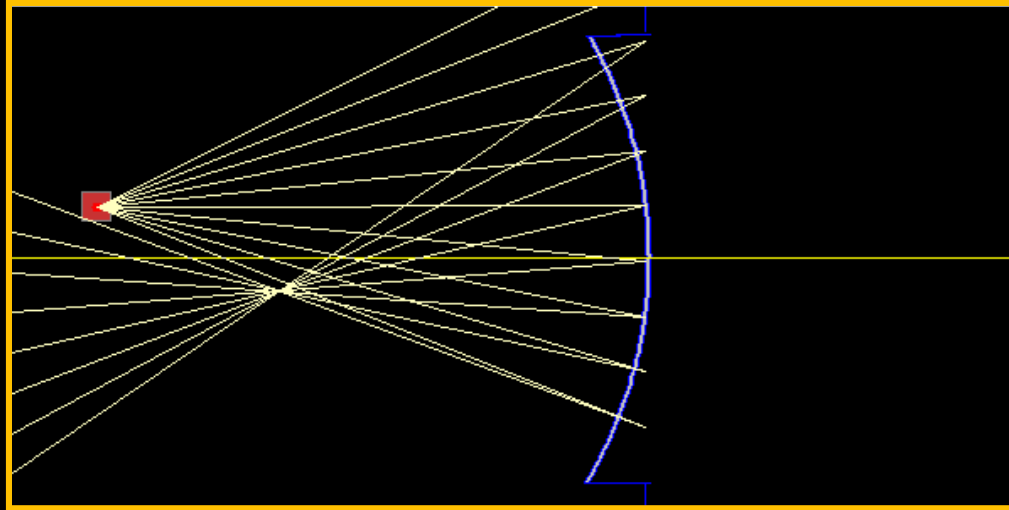


Online archive of Warmup exercises

http://webphysics.iupui.edu/warmup/physics_archive.html

- Introductory physics (2 semester sequence)
- Statistical/Thermal Physics (2 sets)
- Intermediate Mechanics (2 sets)
- Modern Physics, Quantum Mechanics
- Intermediate E&M (2 semester sequence)
- Mathematical Methods
- Optics, Intro Astronomy
- **Needed: Condensed matter, other specialties...**

JiTT Example: Physlets



A point source is located to the left of a mirror. You can drag this point source to any position (**position is given in meters and angle is given in degrees**).

1. Find the focal length of the mirror.
2. Describe the technique you used to determine the focal length.

https://www.compadre.org/Physlets/optics/prob33_1.cfm

Test drive

- Write one warmup question you can use.
- Target the course you will likely teach next
- You have 3-5 minutes, go!

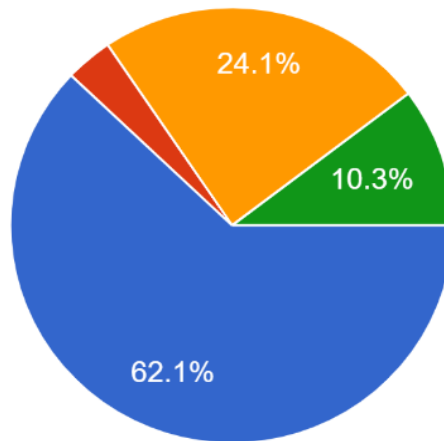
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Choosing and using student responses

Question 3a. A student gives a warm-up response that is seriously incorrect, indicating a deep misunderstanding of the topic. You should

29 responses



- point out the mistake in class, protecting the individual's anonymity.
- contact the student by email or other means.
- not feel the need to address every misunderstanding individually. Discussing the correct ideas in class is enough.
- do something else (none of the above).

Why?

- Other students are likely to have similar misconceptions
- The misunderstanding can be addressed in class without directly referring to a student.
- A mistake indicating a deep misunderstanding of the topic, however serious, should always be addressed while protecting an individual's anonymity. That is the whole purpose of employing good teaching practices. It should bother a teacher that one of the students is not getting the concept.
- If the very incorrect answer is widespread, then you should address it so everyone is clear. If however, it's just one person, then there's no reason to call out the student (even anonymously).
- Keep it positive.

Why?

- JiTT encourages to use warm-up exercises as talking points in the lecture. I think a serious mistake in warm-up exercise is a great opportunity to bring up misconceptions that are needed to be corrected. The same misconception can probably be affecting other students as well, and it would be good to address it without disclosing the identity of the student.
- It is a question of numbers to me- a single (or a few) incorrect response does not need to be addressed in a public setting - this might confuse students who got it correct. If on the other hand a significant fraction (~10%) are not following - then re-iterating the correct concept and clarifying the overall misunderstanding may be required.
- An incorrect response should be addressed, but in a way that does not make a student feel singled out. I would try to avoid any indication that a specific individual misunderstood the material, and would instead treat it as a more general potential misunderstanding.

Choosing and Using Student Responses

- Choose a few typical answers (correct/incorrect)
- Funny is OK (do not mock, but enjoy)
- Always say something positive (even if wrong, especially if a known mis-/pre-conception)
 - A lot of people think this, but it is not quite right.
 - This is true, but what if something else occurs simultaneously...
 - This makes sense, but something is missing...
 - This is a great response... how would we know how much heat to add?

Choosing and using student responses

- Always say something positive
 - This is true, but what if something else occurs simultaneously...
 - This makes sense, but something is missing...
 - This is a great response... how would we know how much heat to add?
 - This is correct, but the reasoning isn't quite right...
 - This has a great beginning, but more could be added...

Choosing and using student responses

- Peer Instruction/Think-Pair-Share
 - Question 3 on the last warmup was pretty tough. Now that we've talked about it, let's do it again with clickers (or cards!)
 - Here's a clicker question based on the warmup
 - Here are three answers to last night's warmup, which is the best?

Tips and Pitfalls

- Explain methods and purpose on first day
- No need to review all responses before class: sample for “useful” quotes, grade later
- Focus on students’ strengths, too, not just misconceptions and other problems.
- Use answers from many students, not favorites.
- Do not “isolate” warmups – use throughout session
- Must be routine. Don’t start/stop mid-semester
- Upper level students can handle more “exploratory” questions, connections to prerequisites
- Faculty cedes some control!

Results

- Students better prepared for class
 - Familiar with jargon
 - Given thought to ideas
- Faculty better prepared for students
 - Misconceptions identified
 - Just in time adjustment to coverage
- Class time spent more productively
 - Students interact during class

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Going Deeper:

- Completely hands on—I have no more slides!
- Writing warmup assignments
 - Planning the assignment
 - Writing questions
- Using student responses
 - What to say
 - How to say it

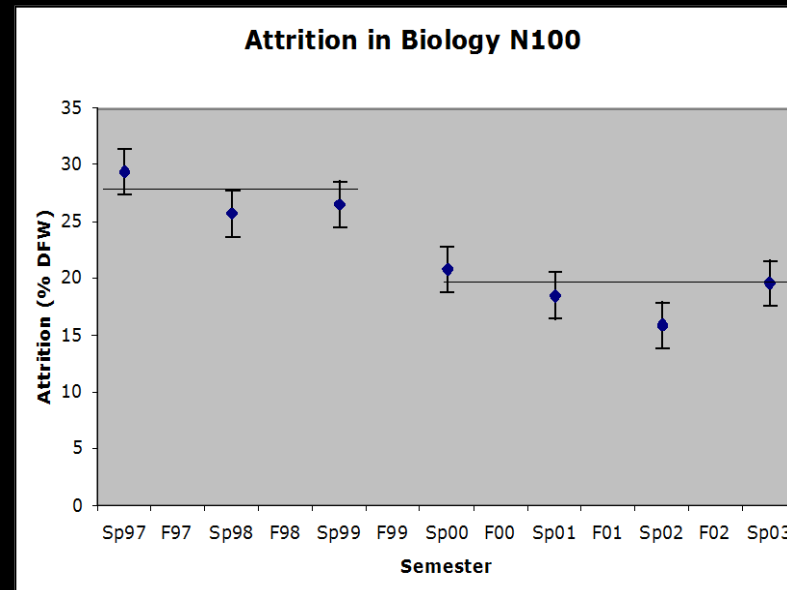
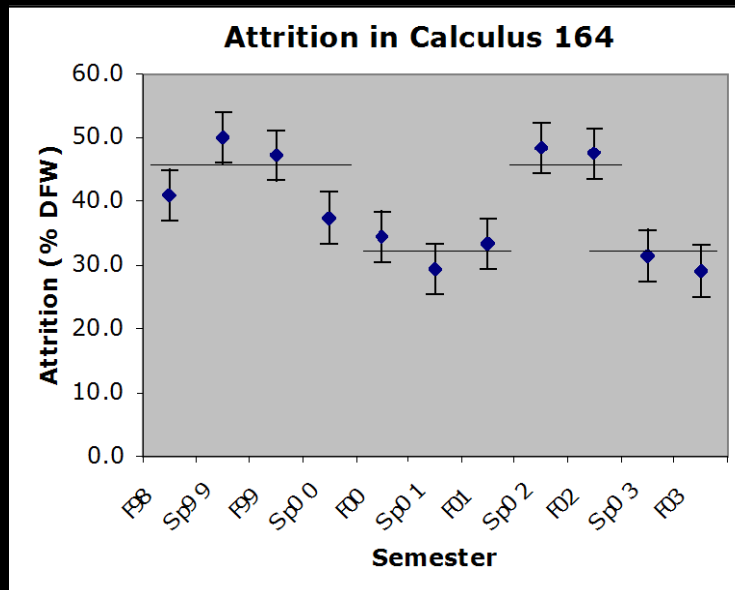
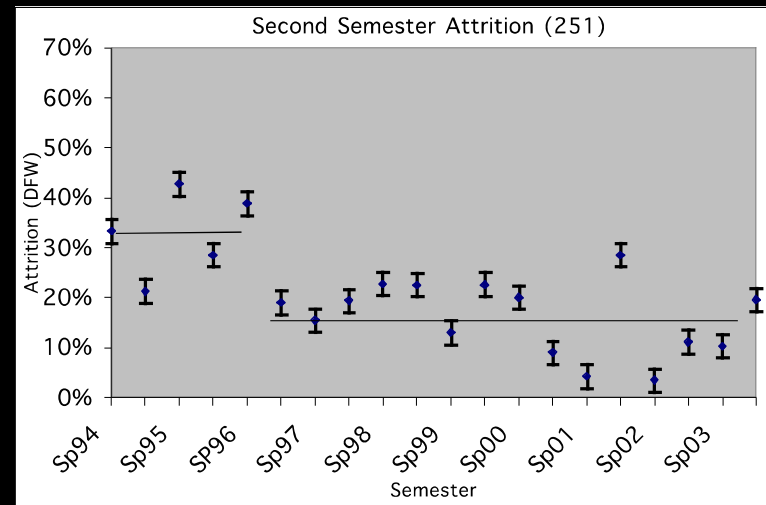
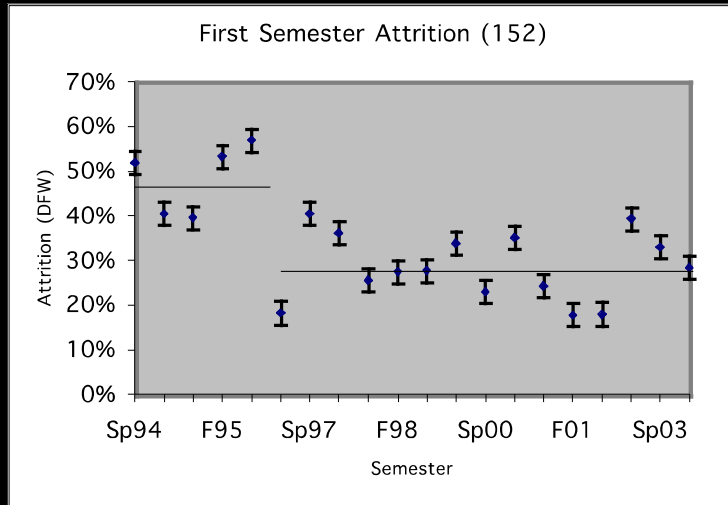
Summary

- JiTT is based on feedback between homework and classroom
- WarmUp exercise: a pre-class, online reading quiz
- Improved study habits, retention, content knowledge, morale.
- Instructor knowledge of student difficulties
- Easily adopted and adapted

How to get great student evaluations

- First five minutes are critical!
- Earn trust—take time on the first day of class to explain what you are doing and why.
- Be a leader—college is hard, and students look to you for motivation, don't disappoint them.
- Build a team—let students know that you and they are working towards a common goal.
- Hold yourself and your students to high standards—if you work hard, they will too.

Retention (N~80-150/semester)



Cognitive (biology, N~200)

Final exam questions tied to...	% Gain (Post%-pre%)	Average Normalized Gain
no interventions	%G = 15% (25%-10%)	$\langle g \rangle = 0.167$
additional homework problems	%G = 17% (35%-18%)	$\langle g \rangle = 0.207$
WarmUp or cooperative learning questions	%G = 45% (59%-14%)	$\langle g \rangle = 0.511$
WarmUp and cooperative learning questions	%G = 56% (68%-12%)	$\langle g \rangle = 0.636$

Affective (E&M, N~60)

1. Do you feel that the warm-up assignments helped your professor make good use of the classroom time?	Yes 47 87%	No 7 13%
2. Do other professors have better ways to determine how class time should be used?	Yes 14 26%	No 40 74%
3. Do you feel that the warm-up assignments helped your professor focus on important topics in class?	Yes 49 91%	No 7 13%
4. Do your other professors have effective methods for focusing on important topics in class?	Yes 33 61%	No 21 39%
5. Did the warm-up assignments help your professor get a good feel for what the students know?	Yes 42 81%	No 10 19%
6. Do your other professors have effective methods for getting a feel for what their students know?	Yes 20 38%	No 33 62%
7. Do you think the warm-up assignments help your professor get students involved during the lecture?	Yes 37 70%	No 16 30%
8. Do your other professors have effective methods for getting their students involved in lecture?	Yes 23 43%	No 31 57%

Student Comments

- “This was a fantastic course. It was the hardest course I’ve taken yet, but also the most fun.”
- I think the WarmUps are a good idea because they give students a chance to think about the material prior to lecture.
- "This course was very well structured. It was obvious that a lot of time was spent in preparation for it."
- "152 & 251 have made me reach more than any courses I have taken."
- Don't tell anyone, but I think I will greatly miss my physics class.