Learning technologies should be designed to increase, and not to reduce, the amount of personal contact between students and faculty on intellectual issues.

(Study Group on the Conditions of Excellence in American Higher Education, 1984)
Goals and Objectives

- to help each student learn to think creatively and critically
- to help students transfer what they have learned
- to help each student learn to think like a scientist/scholar
- to foster genuine rather than superficial learning
- to help students learn to communicate effectively
Outline

JiTT Basics
Some Examples
JiTT Grounding
JiTT As Scholarly Activity
The JiTT Community
Q&A
Pre-instruction warmups

Post-instruction exercises
In some sections of the textbook, “the derivative” refers to a specific number. In other sections, “the derivative” refers to a function. Explain the difference.
Suppose that Eric leads Sean throughout a race. What is the physical meaning of the area between their velocity curves for the first minute of the race?
Briefly discuss the difference between engaging students in inquiry and asking them questions.
Dolly the sheep is a genetic twin, or clone, of a sheep that was born 6 years earlier than Dolly. Read the material for today. Does Dolly have parents? If so, who were her genetic parents? Is Dolly a “virgin birth”? 
Puzzle

Suppose you are standing on the edge of a spinning, playground merry-go-round. You step off, at right angles to the edge. Does this have an effect on the rotational speed of the merry-go-round?

Now consider it the other way. You are standing on the ground next to a spinning merry-go-round and you step onto the platform. Does this have an effect on its rotational speed? How is this case different from the previous case?
Imagine that you were preparing to write an essay in response to this question:
“The development of new types of futures in the late 19th and early 20th century science fiction represented a major break with the kinds of visions of the future that had dominated Western culture since the triumph of Christianity in the Roman Empire. The grand moral perspectives that had characterized older Western futures were replaced by adolescent fantasies that had no higher purpose than attracting an audience.”

Do you agree or disagree? Discuss.

A. Describe in your own words what this question is asking you to do
B. Check the box next to the position you would take, if you were actually answering the question.

1. The quotation is essentially correct, and I would present evidence to convince my readers of that fact.

2. The quotation is essentially incorrect, and I would present evidence to convince my readers of that fact.

3. The quotation is partially correct and partially incorrect, and I would present evidence to convince my readers of that fact.

C. In the boxes below very briefly present three bits of evidence that you would use to support your position and explain after each how it would make your case more plausible.
Question 1.

Part 1. Summarize in your own words Knightley’s arguments that Capa staged this photograph. Summarize in your own words Whelan’s arguments that the photograph is authentic.

Part 2. Whose argument do you find more convincing? Why?
Part 3.

In your opinion, does the issue of whether or not this photograph was staged matter? Why or why not? This is a chance to explore and articulate your ideas about the truth value of photography. While it’s certainly not required, feel free to bring in postmodern theory, if it is part of your personal perspective on photography.
Instructions: After having completed the readings assigned for Session 2, read the following summary of the reports on the International Astronomical Union's recent action regarding Pluto's planetary status. Then answer the four questions at the end of the summary and respond to the survey.

1. Does a change in how something is represented (the modeling domain) change the thing itself (the target domain)? More specifically, does a change in how Pluto is classified change Pluto itself?

2. Does a change in how something is represented (the modeling domain) change our perception of the thing itself (the target domain)? More specifically, does a change in how Pluto is classified change our perception of Pluto?
3. Does a change in how something is represented (the modeling domain) change our understanding of the thing itself (the target domain)? More specifically, does a change in how Pluto is classified change our understanding of Pluto?

4. Does a change in how astronomers represent the solar system undermine the validity of the story that science tells? Does it change "our truth", as the woman from Kansas contends?
ENERGY, MOMENTUM AND DRIVING

When you are sitting in a moving vehicle, you and the vehicle are subject to Newton’s Laws of motion. Your vehicle’s speed and direction and your body’s speed and direction cannot change without external forces. The external force on the vehicle comes from another vehicle which is either moving or stationary, a stationary object, or gravity.

What is Biology Good For?  
A 'Yes or No' in Just 3 Minutes: Home Pregnancy Tests

Chemistry is Good for Making Materials

The Stoichiometry of Carpet Formation

If you want things, you have to build them. In ancient times, people used what was readily available around them, like rocks, trees and mud. Gradually over the years, humans have gotten increasingly adept at taking control of their environment and squeezing new, better materials with which to build things.

"The Maid of Orleans"

Jeanne d'Arc (known as Joan of Arc in English) is one of the most heroic persons in French history. She was born on January 6, 1412, and lived much of her life in the village of Domremy in the duchy of Lorraine. Joan was a peasant girl who tended sheep on the family farm and did not learn how to read or write. During the years preceding Joan’s birth, France had lost several military battles.
The questions asked are critically important.

"...use of IE methods in all components of a course and tight integration of all those components, careful attention to motivational factors and the provision of grade incentives for taking IE activities seriously.”


"Managing THE QUALITY OF CLASSROOM DISCOURSE is the single most important factor in teaching with interactive engagement methods. Effective discourse management requires careful planning and preparation as well as skill and experience."

[DAVID HESTENES, AJP, JUNE 1998]
How People Learn
Brain, Mind, Experience, and School
NATIONAL RESEARCH COUNCIL
Just-in-Time Teaching
Technology Transforming Learning
JiTT addresses the HPL issues

BUT

How is it more than fancy homework?
Group 1 read and summarized a text on the topic... and then listened to a lecture designed to help them organize their knowledge and learn with understanding.

Group 2 did not read the text but, instead, actively compared simplified data sets and then heard the same lecture as Group 1.

Group 3 spent twice as much time as Group 2 working with the data sets but did not receive the organizing lecture.

Group 2 test scores show 100% increase over those in the other two groups.
The "Ersatz Learning vs Genuine Learning" Challenge

Authentic Testing vs. Inauthentic Testing

An authentic test requires that the student performs some real task, similar to what practitioners in the discipline perform.
Arteries
a. Are more elastic than veins
b. Carry blood that is pumped from the heart
c. Are less elastic than veins
d. Both a and b
e. Both b and c

Imagine being asked to design an artificial artery--would it have to be elastic? Why or why not?
As you probably know, the Three Gorges Dam Project will be complete by 2009. When completed, the dam will be the largest hydroelectric dam in the world! Estimate how long you could run computers for each person in our JiTT class with the total power that the Three Gorges Dam will eventually be able to produce in one second. Please EXPLAIN your answer; how are you solving this problem?

The question you give is much different from our Chinese test. Most of time the question is realistic and relates to our daily life. So it is interesting. And sometimes you have to estimate something and give a approximately answer. I think this is a challenge for me because we are educated for the definded answer and all the condition has been given.
Perkins and Thinking Frames

Frame Acquisition

- inventing your own
- soaking up from an enriched environment
- by direct instruction

Research suggests

- Soaking does not occur.
- Modeling, without explicit pointing to the principles modeled leads to little or no learning.
- Instruction should, explicitly, teach frames and/or promote frame invention
Post-instruction JiTT

Teaching content & relevant frames

• Help the student see where the problem belongs in "subject matter space."
• Break the problem into steps.
• Review the setup.
• Change the context a little and repeat.
• Let the student complete the solution.
• Help the student put the solution in perspective.
• Help the student summarize the thought process that led to the solution.
• Give another problem with a major change in context but retain the content.
• Guide the student to the realization that it is "the same problem."
Suppose a swimming pool has two drains. Drain A takes three hours to empty the pool. Drain B takes six hours to empty the pool.

How long does it take to empty the pool if both drains are open?
Suppose a swimming pool has two drains. Drain A takes three hours to empty the pool. Drain B takes six hours to empty the pool.

How much of the pool does drain A empty in one hour? Drain B?
From Community of Practice to Community of Research
Research Components of JiTT Classes

Small CAT’s

Comparisons

Design Experiments
Research Goals

**Question:** Can a classroom environment using constructivist-based JiTT activities improve student performance in Biology?

3. Identify misconceptions students bring to Biology courses.
4. Create interactivity and active learning in large lecture class
5. Improve student study habits and class attendance
6. Increase relevance of studying Biology to everyday life
7. Enhance content knowledge in Biology

**Method:** leverage technology to realize these goals!

**Outcome:** Collect data to determine if this approach is effective in improving student study habits and content knowledge in Biology.
JiTT Improves Study Habits

Warm Ups made a significant difference in student study skills. We asked students to report whether they ‘crammed’ for exams in Biology N100 (JiTT) vs. their other, non-JiTT classes: (n = 426)

<table>
<thead>
<tr>
<th></th>
<th>‘Crammed’ in Biology N100</th>
<th>‘Crammed’ in other courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>A students</td>
<td>16%</td>
<td>44%</td>
</tr>
<tr>
<td>B students</td>
<td>34%</td>
<td>63%</td>
</tr>
<tr>
<td>C students</td>
<td>41%</td>
<td>65%</td>
</tr>
<tr>
<td>D students</td>
<td>64%</td>
<td>71%</td>
</tr>
<tr>
<td>F students</td>
<td>68%</td>
<td>69%</td>
</tr>
</tbody>
</table>
JiTT Improves Class Preparation

1) Do you read the web notes before class?
2) Do you do the readings from the text before class?
3) Do you do read the textbook or the class notes (if provided) before your other classes?

<table>
<thead>
<tr>
<th></th>
<th>(1) Yes</th>
<th>(2) Yes</th>
<th>(3) Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A students:</td>
<td>78%</td>
<td>65%</td>
<td>53%</td>
</tr>
<tr>
<td>B students:</td>
<td>75</td>
<td>72</td>
<td>48</td>
</tr>
<tr>
<td>C students:</td>
<td>63</td>
<td>61</td>
<td>51</td>
</tr>
<tr>
<td>D students:</td>
<td>45</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>F students:</td>
<td>46</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>Biology N100,</td>
<td>n=162</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**JiTT and Content Knowledge**

...but do N100 students ‘learn’ the material any better with this approach? Evidence from Pre- and Post tests, with and without JiTT:

<table>
<thead>
<tr>
<th></th>
<th>Pre-test (% correct)</th>
<th>Warm Up</th>
<th>CL Exercise</th>
<th>Post test (% correct)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitosis</td>
<td>15% 18%</td>
<td>-</td>
<td>-</td>
<td>62% 78%</td>
</tr>
<tr>
<td>Genetics</td>
<td>12% 20%</td>
<td>-</td>
<td>-</td>
<td>48% 64%</td>
</tr>
<tr>
<td>Natural selection</td>
<td>10% 14%</td>
<td>-</td>
<td>-</td>
<td>25% 56%</td>
</tr>
<tr>
<td>Human Population Growth</td>
<td>15% 17%</td>
<td>-</td>
<td>-</td>
<td>65% 85%</td>
</tr>
</tbody>
</table>
Design experiments:

- address learning programs involving important subject matter,
- are usually mediated by innovative technology,
- are embedded in everyday social contexts which are often classrooms,
- can serve as models for broader reform, and
- contribute simultaneously to fundamental scientific understanding of learning and education.
The goal of design experiments is to engineer innovative learning environments and simultaneously understand salient aspects of human cognition and learning involved with those innovations.

We emphasize design experiments as a crucial research approach within the broader context of design partnerships involving teachers, educational researchers, technologists, and scientists.
A Sampling of Questions Proposed by JiTT Faculty

How can JiTT be used to help students move from being passive learners to being active learners?

What types of questions/problems/knowledge/skills explored in JiTT exercises, are most effective in helping students master the material? Why?

How does JiTT influence the depth and timescale of learning retention?
Should JiTT be deployed differently as students progress through a typical four year degree program?

What helps the student feel successful about learning even when most of their answers on JiTT warm-ups are wrong?

How much time is required of the instructor and student in a well designed JiTT course? Do the learning gains justify the cost?
How do we define what “working” actually means when we ask if JiTT is working?

Is the students’ assessment of their own learning correlated to how much and to what depth they actually learn?

How can we measure the degree to which students feel they are in control of the course material?
Just-in-Time Teaching
Technology Transforming Learning

2006
Just-in-Time Teaching
Technology Transforming Learning
Ideals survive through change, they die through inertia in the face of challenge.

Tony Blair