Before we start, please sign on to the online polling system (1 person/device):

1. Go to learningcatalytics.com/demo
2. Enter info, click “Start”
3. Join session 123456789

Also, be sure to sit near someone else so you have a discussion partner during the interactive parts.
Engaging Students One-on-One, All At Once

Peer Instruction Online Course
Singapore Polytechnic
12 November 2014
Introduction

When thinking about your students’ learning, what keeps you up at night?
Introduction

When thinking about your students’ learning, what keeps you up at night?
Introduction

lectures focus on information transfer...
lectures focus on information transfer…

but education is much more!
Introduction

1. Information transfer
1. information transfer

2. assimilation of information
Introduction

1. information transfer (easy)

2. assimilation of information (hard and left to student)
Solution: move information transfer out of classroom!
How to move information transfer out of classroom?
How to move information transfer out of classroom?

Use JiTT (before class) and PI (in class)!
Outline

• PI & JiTT Overview
• Implementing PI & JiTT
• ConcepTests
“How to encourage the unmotivated students to read before class and motivate them to attend class to learn more?”
Just-in-time-Teaching (JiTT)

www.jitt.org
JiTT workflow

- topic 1
- reading assignment
JiTT workflow

- topic 1 reading assignment
- online assignment
JiTT workflow

- topic 1 reading assignment
- online assignment
- 2 conceptual questions
JiTT workflow

- Topic 1 reading assignment
- Online assignment
  - 2 conceptual questions
  - 1 feedback question
JiTT workflow

- topic 1 reading assignment
- online assignment
- review feedback
- 2 conceptual questions
- 1 feedback question
JiTT workflow

1. **topic 1 reading assignment**
2. **online assignment**
3. **review feedback**
4. **address difficulties in class**

- 2 conceptual questions
- 1 feedback question
PI & JiTT Overview

JiTT workflow

- topic 1 reading assignment
- online assignment
- review feedback
- address difficulties in class
- repeat with next topic

- 2 conceptual questions
- 1 feedback question
“How high-level can the JiTT questions be given that students read the material on their own?”
“How long before the class do you release the materials to gain maximum mileage?”
JiTT:

• prepares you for class
• prepares students for class
• helps you address student difficulties
Peer Instruction (PI)
Main features:

- pre-class reading
- in-class: depth, not ‘coverage’
- ConcepTests
brief presentation

ConcepTest
brief presentation

ConcepTest

clicker poll 1
PI & JiTT Overview

brief presentation

ConcepTest

clicker poll 1

> 70% correct
PI & JiTT Overview

brief presentation

ConcepTest

clicker poll 1

> 70% correct

explanation
PI & JiTT Overview

- brief presentation
- ConcepTest
- clicker poll 1
- > 70% correct
- explanation
- repeat from start
PI & JiTT Overview

brief presentation

ConcepTest

clicker poll 1

30–70% correct

> 70% correct

explanation

repeat from start
PI & JiTT Overview

brief presentation

ConcepTest

clicker poll 1

30–70% correct

peer discussion

> 70% correct

explanation

repeat from start
PI & JiTT Overview

brief presentation

ConcepTest

clicker poll 1

30–70% correct

peer discussion

clicker poll 2

> 70% correct

explanation

repeat from start
PI & JiTT Overview

brief presentation

ConcepTest

clicker poll 1

< 30% correct

30–70% correct

peer discussion

clicker poll 2

> 70% correct

explanation

repeat from start
PI & JiTT Overview

brief presentation

ConcepTest

clicker poll 1

< 30% correct
revisit concept

30–70% correct
peer discussion

clicker poll 2

> 70% correct
explanation

repeat from start
PI & JiTT Overview

brief presentation

ConcepTest

clicker poll 1

< 30% correct

revisit concept

30–70% correct

peer discussion

clicker poll 2

> 70% correct

explanation

repeat from start

30–70% correct

peer discussion

clicker poll 2

> 70% correct

explanation

repeat from start

< 30% correct

revisit concept
“If less than 30% students give correct answers to the ConcepTest, we revisit the concept. Then do students take the same ConcepTest again?”
“How does PI work when learners are from different levels?
This might be the case in mixed groups learning.”
“How to implement PI with not motivated students?”
“How do you monitor student discussion? At the end of the day, if there are still students who have poor conceptual understanding after JITT and PI, what can instructors do?”
PI & JiTT Overview

PI:

- helps students overcome difficulties
- encourages deep learning
- provides depth, not “coverage”
- helps you become aware of misconceptions
“What is the percentage of success of PI?”
publications mentioning PI
registered PI users

PI Users Worldwide

as of 2013
“What to do if students who know the answer sit together and students who don’t know the answer sit together?”
find someone with a *different* answer
Online Polling System

1. Go to learningcatalytics.com/demo

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3. Join session 123456789
Let’s try it!

thermal expansion
Let’s try it!

When metals heat up, they expand because all atoms get farther away from each other.
Let’s try it!

When metals heat up, they expand because all atoms get farther away from each other.
Let’s try it!

When metals heat up, they expand because all atoms get farther away from each other.
Consider a rectangular metal plate with a circular hole in it.
Consider a rectangular metal plate with a circular hole in it.

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.
Consider a rectangular metal plate with a circular hole in it.

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.

you got all fired up!
Consider a rectangular metal plate with a circular hole in it.

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.
Consider a rectangular metal plate with a circular hole in it.

When the plate is uniformly heated, the diameter of the hole

1. increases. ✓
2. stays the same.
3. decreases.
consider the atoms at the rim of the hole
Let’s try it!

consider the atoms at the rim of the hole
consider the atoms at the rim of the hole
Let’s try it!

consider the atoms at the rim of the hole
Let's try it!

consider the atoms at the rim of the hole

you won't forget this
“Can we use PI when there are no right or wrong answers?”
“Morality is an informal public system applying to all rational persons, governing behavior that affects others, and includes what are commonly known as the moral rules, ideals, and virtues and has the lessening of evil or harm as its goal.”
Bernard Gert (1934 – 2011)

Moral philosopher
Professor at Dartmouth
Bernard Gert’s moral system created by 10 rules:

1. Do not kill
2. Do not cause pain
3. Do not disable
4. Do not deprive of freedom
5. Do not deprive of pleasure
6. Do not deceive
7. Keep your promises
8. Do not cheat
9. Obey the law
10. Do your duty (as required by job, circumstances).
Heinz’s wife was near death, and her only hope was a drug that had been discovered by a pharmacist who was selling it for an exorbitant price. The drug cost $20,000 to make, and the pharmacist was selling it for $200,000. Heinz could only raise $50,000 and insurance wouldn’t make up the difference. He offered what he had to the pharmacist, and when his offer was rejected, Heinz said he would pay the rest later. Still the pharmacist refused. In desperation, Heinz broke into the store and stole the drug.
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Should Heinz have broken into the store to steal the drug for his wife?
Bernard Gert’s moral system created by 10 rules:

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10. Do your duty (as required by job, circumstances).

Should Heinz have broken into the store to steal the drug for his wife?

1. Yes
2. No
Bernard Gert’s moral system created by 10 rules:

1. Do not kill
2. Do not cause pain
3. Do not disable
4. Do not deprive of freedom
5. Do not deprive of pleasure
6. Do not deceive
7. Keep your promises
8. Do not cheat
9. Obey the law
10. Do your duty (as required by job, circumstances).

Should Heinz have broken into the store to steal the drug for his wife?

1. Yes
2. No
Don’t need a correct answer!
Benefits:

• helps develop conceptual models

• solidifies understanding

• provides feedback

• empowers students
Outline

- PI & JiTT Overview
- Implementing PI & JiTT
- ConcepTests
“Is this similar to flipped class learning?”
Implementing PI & JiTT

“How do I deal with non completion of pre-class assignments?”
“How to motivate students to do pre-assignment especially if it requires them to read articles. Singapore students just do not want to read. Besides awarding them participation marks (extrinsic ways) for doing their pre-assignments/concept test, are there other ways (intrinsic ways) of motivating them?”
“How much time is actually needed to read and process the JiTT results?”
“PI starts with a mini lecture. Is this mini lecture similar to the pre-reading assignments?”
“Does PI work in high school classes, where the content is conceptually not very in-depth, and we also have to work on helping students in the basics, e.g. getting their reading and arithmetic sorted out (which often what we have to do at Singapore Polytechnic)?”
“Have PI and JiTT been tested in a design studio type learning environment? Results and challenges?”
“To successfully implement PI, is it a pre-requisite for instructors to embrace and use facilitation skills in class?”
“Will we be taught how to design ConcepTests since it is the heart of PI?”
Implementing PI & JiTT

“How demanding is this approach on the time of instructor?”
Implementing PI & JiTT

transitioning: where does the effort go?

assign book for course

prepare lecture

deliver lecture

hand out assignment

repeat with next topic

final assessment

prepare reading assignment

review feedback

prepare/select ConcepTests

lead class discussion

hand out assignment

repeat with next topic

final assessment
Implementing PI & JiTT

transitioning: where does the effort go?

1. Assign book for course
2. Prepare lecture
3. Deliver lecture
4. Hand out assignment
5. Repeat with next topic
6. Final assessment

7. Prepare reading assignment
8. Review feedback
9. Prepare/select ConceptTests
10. Lead class discussion
11. Hand out assignment
12. Repeat with next topic
13. Final assessment
New activities:

1. Reading assignment
2. ConcepTests
“How to efficiently review answers to JiTT questions in a class with 100-200 students?”
“Can curriculum be covered within time constraints?”
“Presumably we want to give extra credit to those who participate. What technological tools are available that help us track the participation?”
“In the times I have tried, I don’t get 100% participation, as I saw some students not willing to commit to an answer when they had no clue. Some did not discuss with their neighbours when asked to. Others waited for an answer. Is “I don’t know” a valid option in a ConcepTest?”

“How much time do we give students to answer a ConcepTest? It took me something like 45 minutes to cover seven questions. Do we close the polling after a fixed time limit?”
“How do I do a better job of evaluating my students learning?”
What constitutes a good problem?
On a Saturday afternoon, you pull into a parking lot with unme-metered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.
On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?
On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?

Requires:

Assumptions
Developing a model
Applying that model
On a Saturday afternoon, you pull into a parking lot with unmeetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces. **On average people shop for 2 hours.**

How long do you have to wait before someone frees up a space?
On a Saturday afternoon, you pull into a parking lot with unmeetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces. **On average people shop for 2 hours.**

How long do you have to wait before someone frees up a space?

**Requires:**

- Developing a model
- Applying that model
On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces. On average people shop for 2 hours.

Assuming people leave at regularly-spaced intervals, how long do you have to wait before someone frees up a space?
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Assuming people leave at regularly-spaced intervals, how long do you have to wait before someone frees up a space?

Requires:

Applying a (new) model
On a Saturday afternoon, you pull into a parking lot with unmetered spaces near a shopping area, where people are known to shop, on average, for 2 hours. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?
On a Saturday afternoon, you pull into a parking lot with unmeasured spaces near a shopping area, where people are known to shop, on average, for 2 hours. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?

\[ t_{\text{wait}} = \frac{T_{\text{shop}}}{N_{\text{spaces}}} \]
Implementing PI & JiTT

On a Saturday afternoon, you pull into a parking lot with unme-tered spaces near a shopping area, where people are known to shop, on average, for 2 hours. You circle around, but there are no empty spots. You decide to wait at one end of the lot, where you can see (and command) about 20 spaces.

How long do you have to wait before someone frees up a space?

Requires:

Using a calculator

\[ t_{\text{wait}} = \frac{T_{\text{shop}}}{N_{\text{spaces}}} \]
Need to test meaningful skills!
Need to test meaningful skills!

(what are the goals of your course?)
Outline

• PI & JiTT Overview
• Implementing PI & JiTT
• ConcepTests
“How do I get examples of good questions?”
“Would you mind to share your experience of designing a good ConcepTest?”
Books with ConcepTests:

- Physics (Prentice Hall)
ConcepTests

Books with ConcepTests:

• Physics (Prentice Hall)
• Chemistry (Prentice Hall)
ConcepTests

Books with ConcepTests:

- Physics (Prentice Hall)
- Chemistry (Prentice Hall)
- Astronomy (Prentice Hall)
Books with ConcepTests:

- Physics (Prentice Hall)
- Chemistry (Prentice Hall)
- Astronomy (Prentice Hall)
- Calculus (Wiley)
“Are there helpful short films that can help us learn more about Peer Instruction?”
Videos:

- Interactive Teaching DVD
- From questions to concepts
Google:

<your discipline> ConcepTest

<your discipline> “Concept Test”

<your discipline> “Peer Instruction”
“What are the important parts of a ConcepTest?”
ConcepTests

- intro
- question
- thinking
- poll
- peer discussion
- poll
- wrap up
setting context
ConcepTests

setting context

posing question

intro

question

thinking

poll

peer discussion

poll

wrap up
ConcepTests

- intro
- question
- thinking
- poll
- peer discussion
- poll
- wrap up

setting context
posing question
reflection
ConcepTests

setting context
posing question
reflection
baseline data
setting context
posing question
reflection
baseline data
peer instruction
ConcepTests

- intro
- question
- thinking
- poll
- peer discussion
- poll
- wrap up

setting context
posing question
reflection
baseline data
peer instruction
gain data
ConcepTests

- intro
- question
- thinking
- poll
- peer discussion
- poll
- wrap up
- setting context
- posing question
- reflection
- baseline data
- peer instruction
- gain data
- closure
ConcepTests

- intro
- question
- thinking
- poll
- peer discussion
- poll
- wrap up

- setting context: 5 min (max)
- posing question: 1 min
- reflection: 1–2 min
- baseline data
- peer instruction: 2–3 min
- gain data
- closure: 5 min (max)
potential shortcuts

2–3 min saved, but…

takes the “Peer” out of “Peer Instruction”
ConcepTests

potential shortcuts

- intro
- question
- peer discussion
- poll
- wrap up

launch straight into discussion?
potential shortcuts

1–2 min saved, but...

no opportunity to commit before discussion
potential shortcuts

1–2 min saved, but...

no opportunity to commit before discussion

potential shortcuts

1–2 min saved, but...

no opportunity to commit before discussion

(and no information on effectiveness of CT!)
“How much time do you allocate in a two-hour lecture for the use of Peer Instruction?”
should count on about 15 min per ConcepTest
should count on about 15 min per ConcepTest

(including two pollings)
“How do I make sure my students learn with this method?”
engendering “deep learning”
ConcepTests

engendering “deep learning”

pre-class activity determines context
engendering “deep learning”

question transfers concepts to new context
ConcepTests

engendering “deep learning”

provide *your* explanation
importance of peer discussion
importance of peer discussion

[Flowchart]

- intro
- question
- thinking
- poll
- peer discussion
- poll
- wrap up

vary activity
importance of peer discussion

vary activity, measure poll-repoll gain
ConcepTests

importance of peer discussion

compare poll-repoll gain for 3 activities:

- distract
- reflect
- discuss
importance of peer discussion

poll-repoll change (%)

<table>
<thead>
<tr>
<th></th>
<th>distract</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
importance of peer discussion

![Bar chart showing poll-repoll change (%)]

- **distract**: 15%
- **reflect**: 20%

**Legend:**
- poll-repoll change (%)
- distract
- reflect
importance of peer discussion

- Distract: 4%
- Reflect: 11%
- Discuss: 16%

The graph above illustrates the poll-repoll change (%) for the importance of peer discussion.
Are clickers required?
Are clickers required?

normalized FCI gain:

flashcards: 0.47

clickers: 0.44

Phys. Teacher, 46, 242-244 (2008)
show histograms?
show histograms?

no — biases discussion
ConcepTests

show histograms?

no — biases discussion

yes — helps bring closure
have individual students defend choices?
have individual students defend choices?

gives additional insights for discussion
ConcepTests

have individual students defend choices?

- intro
  - question
  - thinking
  - poll
  - peer discussion
  - poll
  - wrap up

involves students in wrap up
“What are the main characteristics of a good ConcepTest?”
An effective ConcepTest...

- is driven by student needs
- tests understanding, not memorization
- pushes students (but not too much)
Sources of ConcepTests:

- literature/web (you’d be surprised!)
- pre-class assignments
- other assignments
“With this method, can I use only multiple choice questions?”
You can start with free response questions!
Types of questions

- survey
- discussion
- model testing
- select from list
Which of the following airlines tries to save fuel by suggesting that its passengers use the bathroom before boarding?

1. Delta Airlines
2. Lufthansa
3. All Nippon Airways
4. British Midland Airways
5. Air France
6. JAL
7. Aboriginal Air Services
8. Aeroflot
9. Are you kidding me? None of the above.
Which of the following airlines tries to save fuel by suggesting that its passengers use the bathroom before boarding?

1. Delta Airlines
2. Lufthansa
3. All Nippon Airways ✓
4. British Midland Airways
5. Air France
6. JAL
7. Aboriginal Air Services
8. Aeroflot
9. Are you kidding me? None of the above.
hole in plate
moral reasoning
airline
model
discussion
fact
ConcepTests

hole in plate
moral reasoning
airline

model
discussion
fact

fact-recall not engaging
Outline

• PI & JiTT Overview

• Implementing PI & JiTT

• ConcepTests
In closing...

“Experience from those who have used PI? Anyone in my subject (partial differential equations)?”
In closing...

“Experience from those who have used PI? Anyone in my subject (partial differential equations)?”

“Are there any institutions in Singapore that use PI for teaching?”
In closing...

“How do I deal with resistance from the students?”
In closing...

“How do I deal with resistance from the students?”

(to be discussed next session!)
To do before next online session:

1. learn more about Peer Instruction
2. identify resources/ConcepTests in your discipline
3. find PI Users in your discipline
4. review & score ConcepTests
5. create a ConcepTest in your field (optional)
To identify resources in your discipline Google:

<your discipline> ConcepTest

<your discipline> “Concept Test”

<your discipline> “Peer Instruction”
To create YOUR ConcepTests, you need...

1. context

2. question

3. closure
When metals heat up, they expand because all atoms get farther away from each other.
Assignment

Consider a rectangular metal plate with a circular hole in it.

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.
Consider a rectangular metal plate with a circular hole in it. 

**stem**

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.
Consider a rectangular metal plate with a circular hole in it.

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.
Assignment

consider the atoms at the rim of the hole
to create **YOUR** ConcepTests, you need…

1. context
2. question
3. closure
some basic design rules

General tips:

• focus on one idea/concept/model
• keep questions concise
• define all terms
• keep vocabulary simple
Assignment

some basic design rules

Remove:

- barriers for knowledgeable students
- clues for less-knowledgeable students
Writing good “stems”:

- ask complete question
- avoid common knowledge
- avoid negative statements (”not”, “no”, …)

some basic design rules
some basic design rules

Writing good answer choices:

- aim for 3–5 options
- order choices logically
- make all roughly same length
- avoid repeating words (move to stem)
- avoid “All/None of the above”, “Other”
Choose most likely correct answer, based on what you know about informed guessing on tests.

Under what circumstances do *ermazoa* coagulate?

A. Only when *jushespora* increase.
B. Only when *jushespora* change color.
C. When *jushespora* draw into a circle.
D. Usually when *jushespora* increase, but occasionally when *jushespora* decrease.
Example: another nonsense question

What is the color of *ermazoa*?

A. Blue.

B. Red.

C. Green.

D. Yellow.
Which statement refers to measurement as opposed to evaluation?

A. Emily got 90% correct on her math quiz.

B. Mary’s test scores have increased satisfactorily this year.

C. Paul’s score of 20 on this test indicates that his study habits are ineffective.

D. Linda received a B+ for her art project.
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for a copy of this presentation:

http://mazur.harvard.edu

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