Turning lectures into learning

Turning Technologies User Conference
Leiden, Netherlands, 26 October 2016
Turning lectures into learning

@eric_mazur

Turning Technologies User Conference
Leiden, Netherlands, 26 October 2016
Think of something you are good at — something that you know you do well.
Think of something you are good at — something that you know you do well.

*How did you become good at this?*
Became good at it by:

1. trial and error
2. lectures
3. practicing
4. apprenticeship
5. other
some people talk in their sleep
some people talk in their sleep

lecturers talk while other people are sleeping

(Albert Camus)
1. information transfer
1. information transfer

2. assimilation of information
1. information transfer (easy)

2. assimilation of information (hard and left to student)
Peer Instruction
1 Peer Instruction
2 let’s try it!
1 Peer Instruction     2 let’s try it!    3 results
move information transfer out of classroom

- assign reading
- teach by questioning
brief presentation
brief presentation

ConcepTest
brief presentation

ConcepTest

clicker poll 1
brief presentation

ConcepTest
clicker poll 1

> 70% correct
Peer Instruction

1. Brief presentation
2. ConcepTest
3. Clicker poll 1
4. > 70% correct
5. Explanation
brief presentation

ConcepTest

clicker poll 1

> 70% correct

explanation

repeat from start
1 Peer Instruction

- brief presentation
- ConcepTest
- clicker poll 1
  - 30–70% correct
  - > 70% correct
    - explanation
    - repeat from start
brief presentation

ConcepTest

clicker poll 1

30–70% correct

peer discussion

> 70% correct

explanation

repeat from start

1 Peer Instruction
1 Peer Instruction

brief presentation

ConcepTest

clicker poll 1

30–70% correct

peer discussion

clicker poll 2

> 70% correct

explanation

repeat from start
Peer Instruction

1. Brief presentation

2. ConcepTest

3. Clicker poll 1

   a. < 30% correct
      i. Peer discussion
      ii. Clicker poll 2
   b. 30–70% correct
   c. > 70% correct
      i. Explanation
      ii. Repeat from start

4. Repeat from start
Peer Instruction

1. **Brief Presentation**

2. **ConcepTest**

   - **Clicker Poll 1**
     - < 30% correct: **Revisit Concept**
     - 30–70% correct: **Peer Discussion**
     - > 70% correct: **Explanation**

   - **Clicker Poll 2**
     - Repeat from start
1 Peer Instruction

- **brief presentation**
- **ConcepTest**
- **clicker poll 1**
  - < 30 % correct: revisit concept
  - 30–70 % correct: peer discussion
  - > 70 % correct: explanation

- **clicker poll 2**
  - repeat from start
Let's try it!
thermal expansion

1 Peer Instruction

2 let’s try it!
1 Peer Instruction

2 let's try it!
1 Peer Instruction

2 let's try it!
Peer Instruction

let's try it!

All of them
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.
Before I tell you the answer…
Before I tell you the answer, let’s analyze what happened.
Before I tell you the answer, let’s analyze what happened.

You...
Before I tell you the answer, let’s analyze what happened.

You…

1. made a commitment
Before I tell you the answer, let’s analyze what happened.

You…

1. made a commitment
2. externalized your answer
Before I tell you the answer, let’s analyze what happened.

You...

1. made a commitment
2. externalized your answer
3. moved from the answer/fact to reasoning
Before I tell you the answer, let’s analyze what happened.

You...

1. made a commitment
2. externalized your answer
3. moved from the answer/fact to reasoning
4. became emotionally invested in the learning process
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 atoms at rim of hole
consider atoms at rim of hole

1 Peer Instruction
2 let's try it!
consider atoms at rim of hole
consider atoms at rim of hole
consider atoms at rim of hole

you won’t forget this

Peer Instruction  let’s try it!
1 Peer Instruction  

2 let’s try it!
Bernard Gert (1934 – 2011)

Moral philosopher
Professor at Dartmouth

1 Peer Instruction
2 let’s try it!
Bernard Gert (1934 – 2011)

Moral philosopher
Professor at Dartmouth

“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’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).

Peer Instruction let’s try it!
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.
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.

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

you got all engaged!

Peer Instruction
let’s try it!
traditional instruction

1990 FCI posttest

Peer Instruction  
let’s try it!  
results
traditional instruction

1991–1994 FCI pretest

Peer Instruction  let’s try it!  results
traditional instruction

1990 combined

Peer Instruction  let's try it!  results
first year of implementing PI

![Histogram of 1991 FCI pretest scores]

- **Peer Instruction**: 1
- **let’s try it!**: 2
- **results**: 3
first year of implementing PI

1  Peer Instruction
2  let’s try it!
3  results
first year of implementing PI

![Bar chart showing scores and counts for 1991 combined]
what about problem solving?
1985 exam scores

<table>
<thead>
<tr>
<th>Exam score (%)</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>17</td>
<td>5</td>
</tr>
<tr>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>21</td>
<td>5</td>
</tr>
<tr>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>24</td>
<td>5</td>
</tr>
<tr>
<td>25</td>
<td>5</td>
</tr>
</tbody>
</table>

Peer Instruction  2  let’s try it!  3  results
1991 exam scores

Peer Instruction
let’s try it!
results
better understanding leads to better problem solving

1985/91 exam scores

Peer Instruction    let's try it!    results
1 Peer Instruction
2 let’s try it!
3 results
in a lecture, students...
in a lecture, students...

1. don’t pay utmost attention
in a lecture, students...

1. don’t pay utmost attention
2. think they know it

1 Peer Instruction  2 let’s try it!  3 results
2 short video lectures on calico cats, same content


1 Peer Instruction 2 let’s try it! 3 results
2 short video lectures on calico cats, same content

fluent video

speaks fluidly w/o notes
upright
maintains eye contact


1 Peer Instruction  2 let’s try it!  3 results
2 short video lectures on calico cats, same content

fluent video

- speaks fluidly w/o notes
- upright
- maintains eye contact

disfluent video

- speaks haltingly from notes
- slumped
- looks away


1 Peer Instruction  2 let’s try it!  3 results
judgement of learning

mean performance (%)

- predicted

fluent disfluent


1 Peer Instruction 2 let’s try it! 3 results
judgement of learning

![Bar graph showing mean performance](image)

1. Peer Instruction
2. let’s try it!
3. results

Judgement of learning

- Peer Instruction
- Let’s try it!
- Results
in a lecture, students…

1. don’t pay utmost attention

2. think they know it
in a lecture, students...

1. don’t pay utmost attention
2. think they know it
3. are not confronted with misconceptions
in a lecture, students...

1. don’t pay utmost attention
2. think they know it
3. are not confronted with misconceptions

false sense of security

1 Peer Instruction  2 let’s try it!  3 results
1 Peer Instruction
2 let's try it!
3 results
an illusion...
Education is not just about:

- transferring information
- getting students to do what we do
Education is not just about:

- transferring information
- getting students to do what we do

active participation a must!

1 Peer Instruction  2 let’s try it!  3 results
not just a polling tool, but an engagement tool!
PeerInstruction.net

Join now!
Research Funding:

Pew Charitable Trust, Pearson/Prentice Hall, Davis Foundation, Engineering Information Foundation, Derek Bok Center for Teaching and Learning, National Science Foundation

for a copy of this presentation:

http://mazur.harvard.edu

more information:

www.turningtechnologies.com

Follow me! eric_mazur
Research Funding:

Pew Charitable Trust, Pearson/Prentice Hall, Davis Foundation, Engineering Information Foundation, Derek Bok Center for Teaching and Learning, National Science Foundation

for a copy of this presentation:

http://mazur.harvard.edu

more information:

www.turningtechnologies.com

Follow me! eric_mazur