Educating the innovators of the 21st century



Strategies for Innovation and Engineering Education in Brazil Cambridge, MA, 30 October 2012



Educating the innovators of the 21st century



@eric_mazur

Strategies for Innovation and Engineering Education in Brazil Cambridge, MA, 30 October 2012 Innovation

Nobel Prize in Physics 2010



Nobel Prize in Physics 2010

Ig Nobel Prize in 2000



"For me it's very boring to work on the same thing year after year..."

"For me it's very boring to work on the same thing year after year..."

graphene resulted from

"Friday night experiments where you try something very elementary and try to go in another direction"

how can we foster/teach innovation?



Need to...

teach problem solving

encourage risk taking



- no ON/OFF button
- only last "click" counts
- display shows recorded answer

www.TurningTechnologies.com



www.TurningTechnologies.com



www.TurningTechnologies.com

Think of something you are good at

Think of something you are good at

How did you become good at this?

Became good at it by:

- 1. trial and error
- 2. lectures
- 3. practicing
- 4. apprenticeship
- 5. other





















better pay attention!





a statistical



What happens in a lecture?











some people talk in their sleep

lecturers talk while other people are sleeping

(Albert Camus)

















education is not just information transfer





education is not just information transfer





education is not just information transfer














only one quarter of maximum gain realized



R.R. Hake, Am. J. Phys. 66, 64 (1998)



not transfer but assimilation of information is key



conventional problems misleading





conventional problems misleading

Calculate:

(a) current in 2- Ω resistor

(b) potential difference

between *P* and *Q*









are the basic principles understood?

When S is closed, what happens to:

(a) intensities of A and B?

(b) intensity of C?

(c) current through battery?

(d) potential difference across

A, B, and C?

(e) the total power dissipated?





conventional

conceptual







conventional





conceptual



















assessment promotes memorization and stifles creativity





















education



































assessment incompatible with real problem solving



• focuses on outcome, not process



- focuses on outcome, not process
- discourages risk taking



- focuses on outcome, not process
- discourages risk taking
- focuses on individual, not group



- focuses on outcome, not process
- discourages risk taking
- focuses on individual, not group
- does not mirror future work environment





education



1. transfer of information






1. transfer of information

2. assimilation of that information





1. transfer of information (in class)

2. assimilation of that information





1. transfer of information (in class)

2. assimilation of that information (out of class)





Should focus on THIS!

1. transfer of information (I)

2. assimilation of that information (out of class)





1. transfer of information (in class)

2. assimilation of that information (out of class)





1. transfer of information (out of class)

2. assimilation of that information (in class)





1. transfer of information (out of class)

2. assimilation of that information (in class)



































thermal expansion































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

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









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

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







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

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























You...

1. made a commitment







You...

made a commitment
externalized your answer







You...

- 1. made a commitment
- 2. externalized your answer
- 3. moved from the answer/fact to reasoning







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







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

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









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

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









consider atoms at rim of hole









consider atoms at rim of hole








consider atoms at rim of hole









consider atoms at rim of hole









consider atoms at rim of hole

























first year of implementing Pl









first year of implementing Pl









first year of implementing PI











PI











2 PI









what about problem solving?































So better understanding leads to better problem solving!







So better understanding leads to better problem solving!

(but "good" problem solving doesn't always indicate understanding!)





































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







in a lecture, students...

1. don't pay utmost attention

2. think they know it

3. are not confronted with misconceptions







Security 1. don't pay utmost attention

2. think they know

of fonted with misconceptions

in a lecture, students...









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!







With a simple change, Peer Instruction...

- teaches real problem solving
- encourages risk taking






First International Asia-Pacific Conference on Peer Instruction

Beijing, China 14-15 December 2012



PeerInstruction.net

Funding:

National Science Foundation

for a copy of this presentation:

mazur.harvard.edu











		 _

Google Search	I'm Feeling Lucky
---------------	-------------------



mazur			

n Feeling Lucky
1



mazur		





mazur		

Google Search	I'm Feeling Lucky
	1

Funding:

National Science Foundation

for a copy of this presentation:

mazur.harvard.edu







