Moving towards student-centric teaching

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A little bit about you …

I (mainly) teach

1) English
2) Maths
3) Pre-primary
4) Science
5) Social Studies
6) Computer Science
7) Other …

Warm up

Think of one activity that you feel you excel at doing.

Write down your answer. You need not share this with anyone!

Think about why you are so good at this activity.

Write down the top 3 reasons for your mastery in this activity.

Let me guess - One of your top 3 reasons is likely to be:

– Practice. "Experience"

Practice

Again, think of the activity that you feel you excel at doing.

Do you feel that you could have gained such mastery by listening to lectures on the topic?

Point to keep in mind:
As learners, we develop mastery through practice (doing activities, rather than simply listening to lectures, or watching demos).

So,
As teachers, we must ensure that we provide our students with practice – sufficient and timely opportunities.

Workshop Goals

In this workshop you will:

- Experience some research-based strategies for improving learning.
- Design some effective learning activities for your class.
- Share some best-practices from your school.

Debate

Consider two teachers – A and B.

Teacher A gives an excellent lecture in the class, demonstrates solving many problems, and gives appropriate homework to her students.

Teacher B does not lecture continuously nor does she give as much homework. Instead, she makes her students do activities in class, that lets them practice what they have learned immediately, and ensures that they get feedback on their work.

Form two groups.

- GROUP A – Write points for when Teacher A's methods are better.
- GROUP B – Write points for when Teacher B's methods are better.

Debate

TEACHER A

Can do lively demos, examples

Large classes, A method seems more feasible

Teacher may be role model, give foundation, may demonstrate ideas, skills

Portion complete

Students asks Q, get clarification

TEACHER B

Collaboration between students

Curiousity,

Student do things

Apply, analyze, assimilate

Debate (Teacher A vs Teacher B)

So which group won ☺?

Let’s summarize.

A - 20th Century Teacher

Teacher A gives an excellent lecture in the class, demonstrates solving many problems, and gives appropriate homework to her students.

In the 20th century, information was at a premium – No Internet, expensive books, limited access to libraries, and so on.
Hence, those who had access the information and could transmit it effectively were highly valued.

So, students were mostly passive listeners, absorbing information during the lecture, and doing their practice later.

What has changed in the 21st century?

B – 21st Century Teacher

Teacher B does not lecture continuously nor does she give as much homework. Instead, she makes her students do activities in class, that lets them practice what they have learned immediately, and ensures that they get feedback on their work.

In the 21st century, information is no longer at a premium – lot of accessible videos, demos, and so on.
Hence, it is not enough for a teacher to only transmit information effectively.

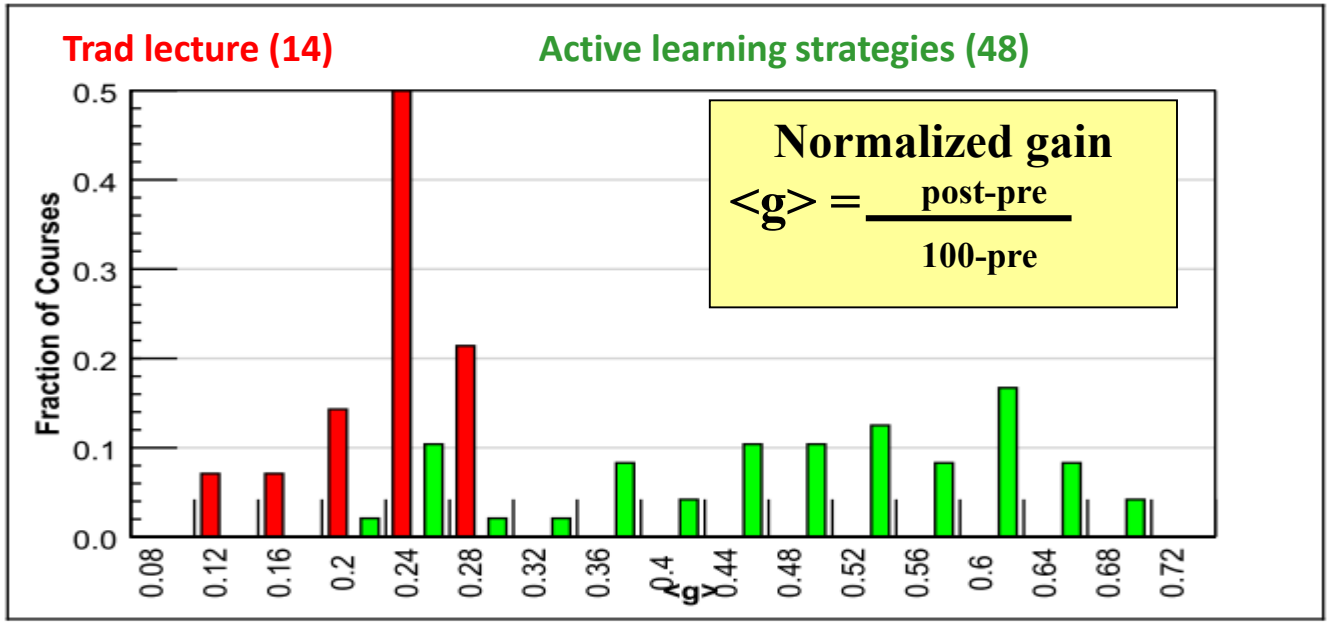
It is necessary for a teacher to ensure that her students are able to assimilate the information, through appropriate practice, during the lecture itself.

Shift of focus from Teacher-Centric to Learner-Centric pedagogy.

Evidence from research

Comparative study of 62 Physics courses (1998)

- 6542 students
- Variety of institutions: high school, college, university
- Semester long physics course
- Pre-post test of conceptual reasoning – Force Concept Inventory



IMPLICATION

Desirable to explicitly incorporate learner-centric activities in our teaching.

RESULTS:

- Maximum gain from lecture courses was 0.28
  - Many instructors had high teaching evaluation scores
- Gain from learner-centric courses had gains 0.23-0.7, which was 2-3 times greater than lectures

R. Hake, "Interactive-engagement versus traditional methods: A six-thousand student survey of mechanics test data for introductory physics courses" Am. J. Phys., **66** (1998)

How to do learner-centric pedagogy

One way – Active learning techniques.

- Students go beyond listening, writing notes, executing prescribed procedures.
- Students asked to 'figure things out' *during class.*

Needs attitude shift of teacher:

- from content-oriented to learning-oriented.
- from "How well am I lecturing?" to "How well are they learning?"

Many teachers say - My lectures are plenty interactive!

- *I often pause to ask students if they understood the material.*
- *I allow students to interrupt whenever they have doubts.*
- *I never hesitate to answer their questions.*
- *I show them demos and videos.*

….

Isn’t this active learning?

Why ‘interactive lectures’ may not be enough

- Students don’t pay utmost attention throughout the lecture.
- Students *think* that they understand because they can follow the lecture.
  - They are not confronted with their misconceptions immediately.

- Difficult to ensure that all students in the class participate actively.
  - Students with high motivation / achievement levels drive the pace.
  - Students with low achievement levels get left behind.

- Students may have a barrier to responding directly to the instructor.
  - Shy students don’t ask questions, or give answer, even if they have one.
  - Forcing all students to respond tends to be counter-productive.

So, what are active learning strategies?

Requirements:

- Students go beyond listening, copying of notes, execution of prescribed procedures.
- Instructor designs activities that require students to talk, write, reflect and express their thinking.

- Explicitly based on theories of learning.
- Evaluated repeatedly through empirical research.

Let us see an example

D. E. Meltzer and R. K. Thornton. "Resource letter ALIP–1: active-learning instruction in physics." *Am. J. Phys,* 80.6 (2012): 478-496

Vote individually

A large piece of ice is floating in water in a bucket. When it melts what will happen to the water level in the bucket?

1. It will rise.
2. It will fall.
3. It will stay the same

Discuss with your neighbour and converge

A large piece of ice is floating in water in a bucket. When it melts what will happen to the water level in the bucket?

1. It will rise.
2. It will fall.
3. It will stay the same

Have you converged? Then revote.

A large piece of ice is floating in water in a bucket. When it melts what will happen to the water level in the bucket?

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Why do active learning techniques work?

What do students do? (in previous example “students”=you)

- Talk, argue, listen (sometimes), reason, draw, … ==> *engaged with content*
- Learn from each other, teach each other (teach<=>learn)
- Those who don’t know are willing to think, reason, answer
- Those who do know are willing to participate (teach? show-off?)
- Pre-existing thinking is elicited, confronted, resolved

What are other benefits? To instructor? To class atmosphere

- Immediate feedback to instructor
- Students realize that even others are struggling
- Builds a friendly, yet scientific atmosphere
- Improves communication

Activity

Consider the class that you are teaching.

Think: How will you incorporate active learning? List one way you have already done – or how will do so.
Write down your answer, as specific as you can. [~2 minutes]

Pair: Do a self-check using the next slide to check if your activity is learner centric. [~3 minutes]

Share: Merge answers of the entire group. [~5 minutes]

Info: Think-Pair-Share activity you is an effective active learning strategy.

Self-check:
Moving from teacher-centric to learner centric strategies

Did your strategy begin with:

"I will do …"

"I will show …"

"I will tell…"

Then it is still teacher-centric.

To be learner-centric, the strategy should begin with:
"I will make students do …"

Or better still
" Students will do …"

Activity: Answers from audience

- Grade 5 science . Parts of brain. Pose Qs, show video, students watch videos, ans Qs.
- Grade 9, Maths. Compound interest. Students give principal to friend, decide interest rate.
- Maths, formula – based problem, do it wrong, ask students to point error
- Chem, structure of atom. What is universe made of?
- Hindi. Debate.
- CS Class 11. Give Q to write code. Students write the code, correct in pair.
- Biology. Bring leaves into class, distribute in class. Students
- Pre primary – role play of a story
- English . Pairs . One person reads, other explains.

Back from tea break

Summary - Features of active learning strategies

Students engage in problem-solving activities *during* lecture.

Students work collaboratively.

Students are asked to "figure things out for themselves."

Ensure (most) students participate

Students are asked to express their reasoning explicitly.

Qualitative reasoning, conceptual thinking are emphasized.

Target misconceptions

Specific student ideas are elicited and addressed.

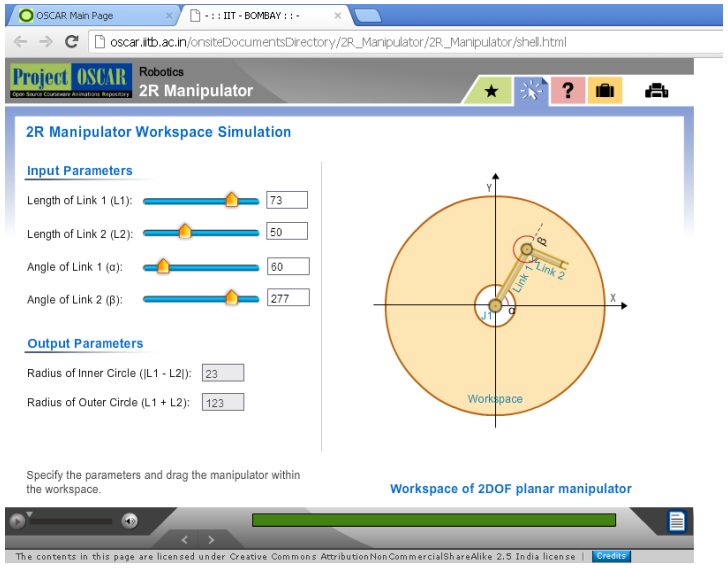
Students receive rapid feedback on their work.

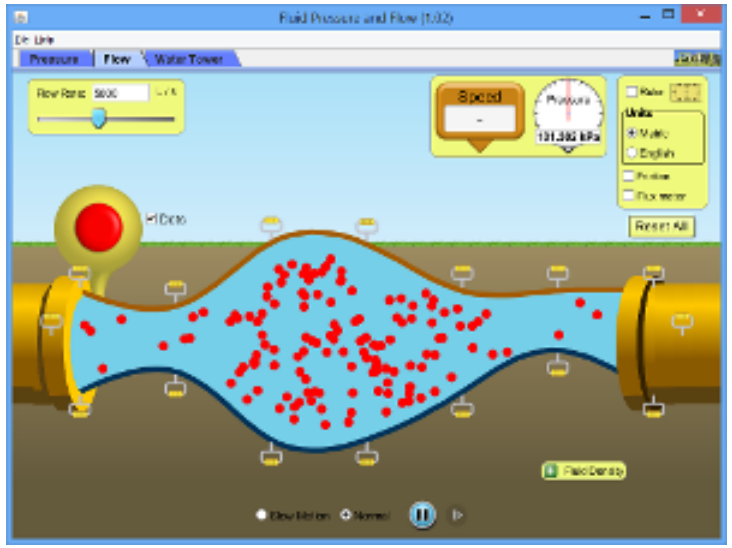
Go from '… think they understand' to '… know whether or not they understand'

Scenario 2: Using visualizations in class

Visualizations such as animations and simulations have been shown to provide many learning benefits, especially in STEM disciplines.

Many teachers report using such visualizations in their class. Most play or demonstrate the animation in class, along with narrative explanation.





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Visualizations such as animations and simulations have been shown to provide many learning benefits, especially in STEM disciplines.

Many teachers report using such visualizations in their class. Most play or demonstrate the animation in class, along with narrative explanation.

VOTE - Do you think demo & explanations of visualization is effective?

1) Yes
2) No

Why or Why not?

Benefits of visualization

- Visual medium hence memory stays longer
- Useful for topics which are hard to visualize or invisible
  - Historical events
  - Earthquakes
  - Volcano
  - Space
  - Places not explored
- Abstract topics
- Process depiction, steps

What do you mean by “effective”?

Do you think demo & explanations of visualization is effective?

Each table say one

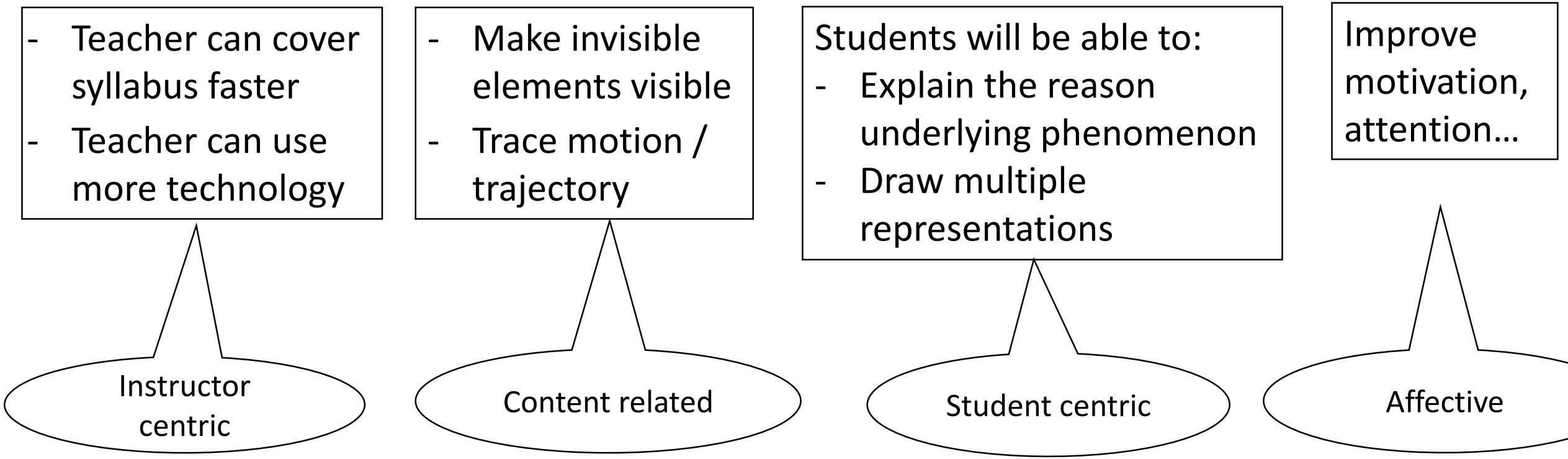
- Student understands concept
- Applies concept
- Visualization esp of invisible (atoms, nerve impulse) or hard to visualize (blood flow, globe), abstract (calculus, cloud (CS), virtual memory)
- Pronunciation in language
- Attractive , engagement
- Pictures – useful for students
- Hard to draw …

What do you mean by effective?

Responses from previous workshop

- Engage students
- Learning outcomes improves
- Students do some sense-making
- Motivation improves
- To lead to a desired output based on reasonable inputs
- Learning of content, facts, concepts
- Viz is effective if students are able to see invisible objects
- Visualize objects hard to imagine - mirage
- Grasp attention of student
- Visualization shd not lead to misconception

What do you mean by effective - Perspectives



Which of these goals can be achieved by demo of visualizations?

Results from research on use of visualizations

- Showing demo alone is not effective esp for student learning (Hansen et al 2000)
- Potential benefits of visualization is lost if students merely watch (Lindgren & Schwartz)
- The way the instructor teaches with the visualization has a profound effect on learning effectiveness (Bratina et.al, 2002).

- Active-learning instructional strategy with visualization led to improved outcomes than mere viewing (Laasko et al 2009; Windschitl & Andre 1998, Banerjee, Murthy & Iyer 2015)

How to incorporate structured active learning strategies?

One way – Use Peer Instruction questions

Peer Instruction is a structured Active Learning strategy (recall ice-bucket Q)

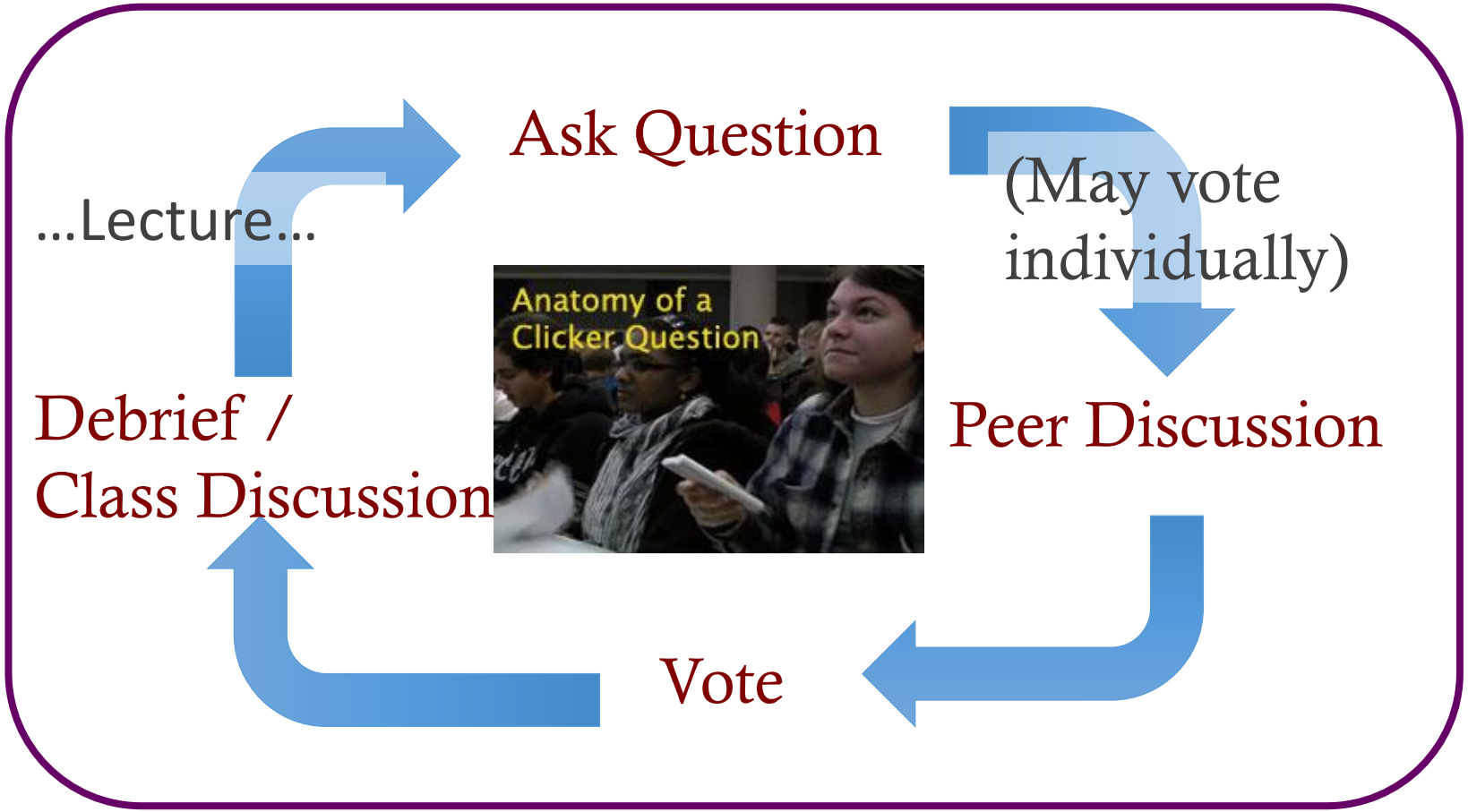
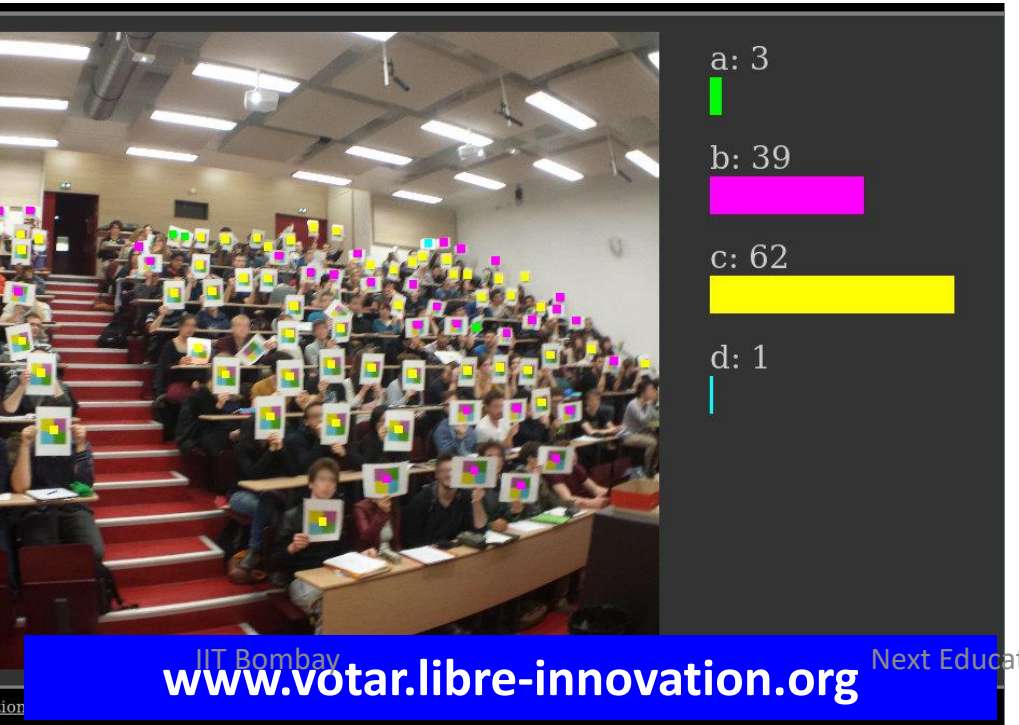
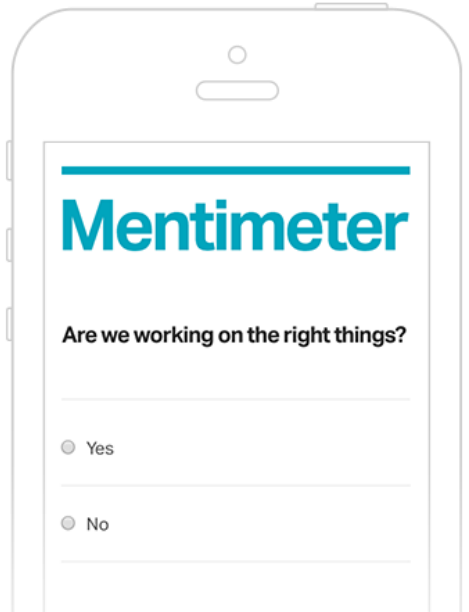


Figure attributed to: Stephanie Chasteen and the Science Education Initiative at the University of Colorado

Implementation of Peer-Instruction





www.votar.libre-innovation.org

www.mentimeter.com

Example of PI question with visualization– Predict outcome

Observe Phase

TEACHER:
- Play viz upto the point the stimulus is shown.
- PAUSE before result. Don't show rest of viz yet.

STUDENTS:
Observe first part of viz

Predict Phase

TEACHER:
- Ask students to make prediction: "What will happen if …"

STUDENTS:
- **Make prediction – write, vote, discuss w each other**

Will the balloon move?

A) Yes, to the left

B) Yes, to the right

C) No

Check Phase

TEACHER:
- Shows rest of viz, which has result

STUDENTS:
- Check their prediction by watching the result in viz

Show rest of movie

http://paer.rutgers.edu/pt3/experiment.php?topicid=13&exptid=121

Writing your own Peer Instruction questions

- There are guidelines for writing peer instruction questions of different types.

- Let’s go through some types.
  - We already saw an example of PI question to predict the outcome of an experiment.

- Examine if suitable for your class and write a question.

Example:
Peer Instruction question for (difficult) concept

A small mango seed can grow into a big tree in a few years. Where does most of the tree's mass come from as the tree grows?

1) Minerals in the soil
2) Water from rainfall
3) Gases in the air
4) Sunlight

Note – this and the next few questions are not meant to test your knowledge! Please wear your 'Teacher-hat'. Think – why /when is this is useful question?

Example:
Peer Instruction question for reasoning (science)

What would happen to the seasons if the earth's orbit around the sun was made a perfect circle (but nothing else changed) ?

1) There would be no seasons
2) The seasons would remain pretty much as they are today
3) North hemisphere would be always Hot, South always cold.
4) Same seasons in North and South hemisphere at same time

Example:
Peer Instruction question for reasoning – connecting words to diagrams (English)

Which of the following statements does the picture best represent?

1) The apple is about to fall from the tree
2) The apple is falling from the tree
3) The apple has fallen from the tree
4) The apples have fallen from the tree

What makes a good peer-instruction question?

An effective peer-instruction question:

- Is usually conceptual (avoid long analytic computation)
- Elicits pre-existing thinking, students' alternate conceptions
- Has believable distractors
- Asks students to predict results of experiment, or algorithm
- Makes students apply ideas in new context
- Relates different representations

- is not ambiguous
- is not leading
- is not 'trivial'

Your turn – write your own question

Work with a partner who teaches the same subject as you.

Choose a topic in your subject that you are teaching this semester.

Write a peer-instruction question of one of the types we have seen:

- Predict outcome of an experiment, then show a video for outcome
- A difficult concept (not useful to ask PI Qs for simple definitions)
- Reasoning
- Connecting words to diagrams (good maths questions are possible)

Share a few questions

Audience responses

*

Will you implement Peer Instruction?

1) Yes definitely, more than once
2) I will try at least once a week
3) I would like to but I have concerns
4) I do not intend to try

Note – Peer Instruction can be used for such opinion questions, followed by discussion. Let us discuss some of your concerns.

Your Concerns

- Time
- How to frame Qs
- What to do if unexpected answers
- Class control

Common Concerns

- Too much noise in class!
- How can I complete the syllabus?

Other structured active learning techniques

- Peer-Instruction *(Eric Mazur, Harvard University, early 1990s)*
- Think-Pair-Share *(Frank Lyman, University of Maryland, early 1980s)*
- Many others:
  - (lecture) Team-Pair-Solo, Problem-based learning, Just-in-Time-Teaching, Role-play, Jigsaw, Case-based learning, Peer-review, Productive failure …
  - (lab) Pair problem solving.
  - (tutorial) TPS, TPS, PBL, Data-based problem solving.

- See http://www.et.iitb.ac.in/TeachingStrategies.html

Takeaway

Make students grapple with content *during class.*

Don’t only clarify doubts, use proven methods like active learning strategies.

- Provide frequent opportunities for learners to work with the content – Active learning.
- Ensure immediate and appropriate feedback to learners – Peer discussion.

Acknowledgements

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