# Improving learning and learner engagement in f2f and blended settings

Sahana Murthy

Educational Technology

IIT Bombay

Training and Development in RBI – Bridging the Gaps

March 30, 2019

# What is Educational Technology?

The study and ethical practice of facilitating the learning experience and improving performance by creating, using, and managing appropriate technological processes and resources.
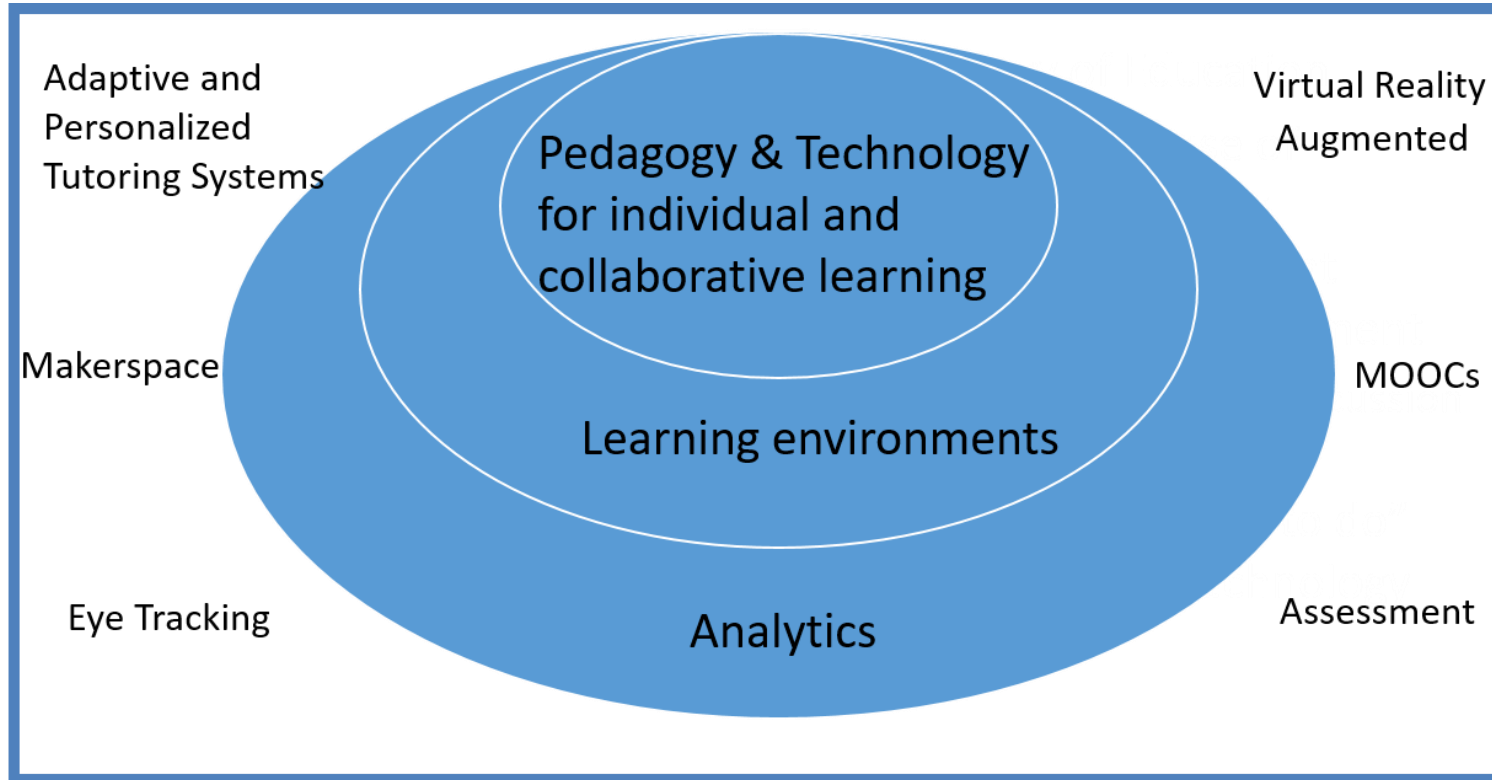
*-Wikipedia*

# What is Educational Technology?

A combination of processes, strategies and tools involved in addressing educational needs and problems, with an emphasis on applying current technologies.

*-Integrating educational technology into teaching, 4th ed., M.D.Roblyer*

# What is Educational Technology?

Adaptive and Personalized Tutoring Systems

Virtual Reality Augmented

Makerspace

MOOCs

Pedagogy & Technology for individual and collaborative learning

Learning environments

Eye Tracking

Assessment

Analytics

# Educational Technology @ IIT Bombay

- Inter-Disciplinary Program, started 2010

- Faculty
  - 5 Core faculty
  - Associate from depts of Engg, Science, Design, H&SS

- PhD program : 20 research scholars, 12 alumn

- Starting MTech – 2019
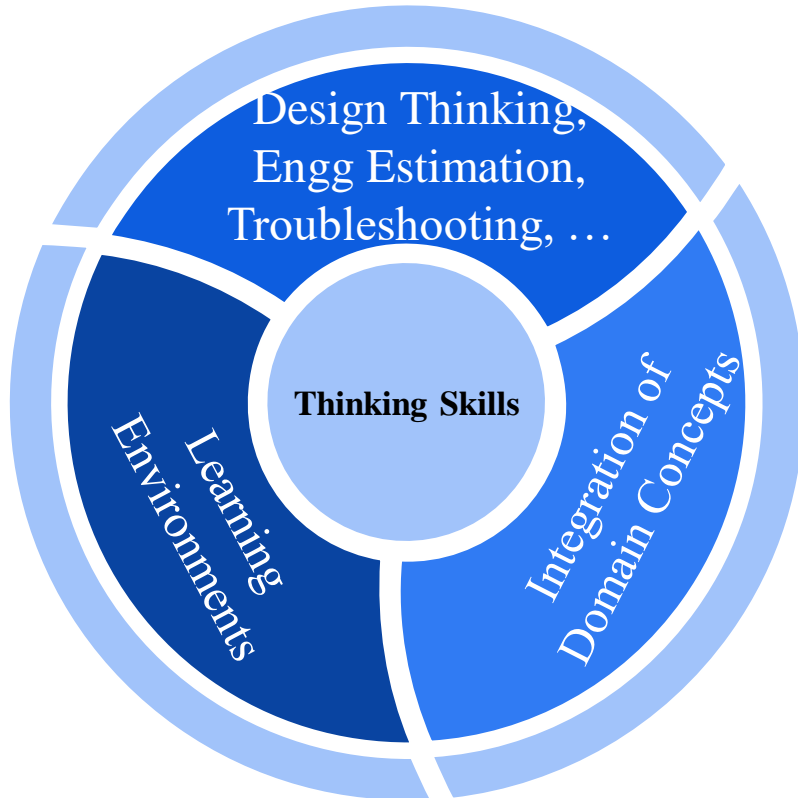
# ET@IITB : What do we do?

Research

Development

Consultancy

Outreach

Sponsored Projects

Sponsored Research Labs

Design Thinking,
Engg Estimation,
Troubleshooting, …

Thinking Skills

Learning Environments

Integration of Domain Concepts

Pedagogical agent to guide student

This is incorrect. You need to make careful observations and answer the rest of the questions. Go back and vary voltage and observe what happens in the microscopic model of the PN junction

Personalized feedback

Micro World: IF THIS...    Macro World: THEN THAT...

PN Junction

Your Answer

Zoom In!

Interactive simulation for virtual experimentation

Yes! They Match.

Experimental Graph from laboratory

On-demand hints

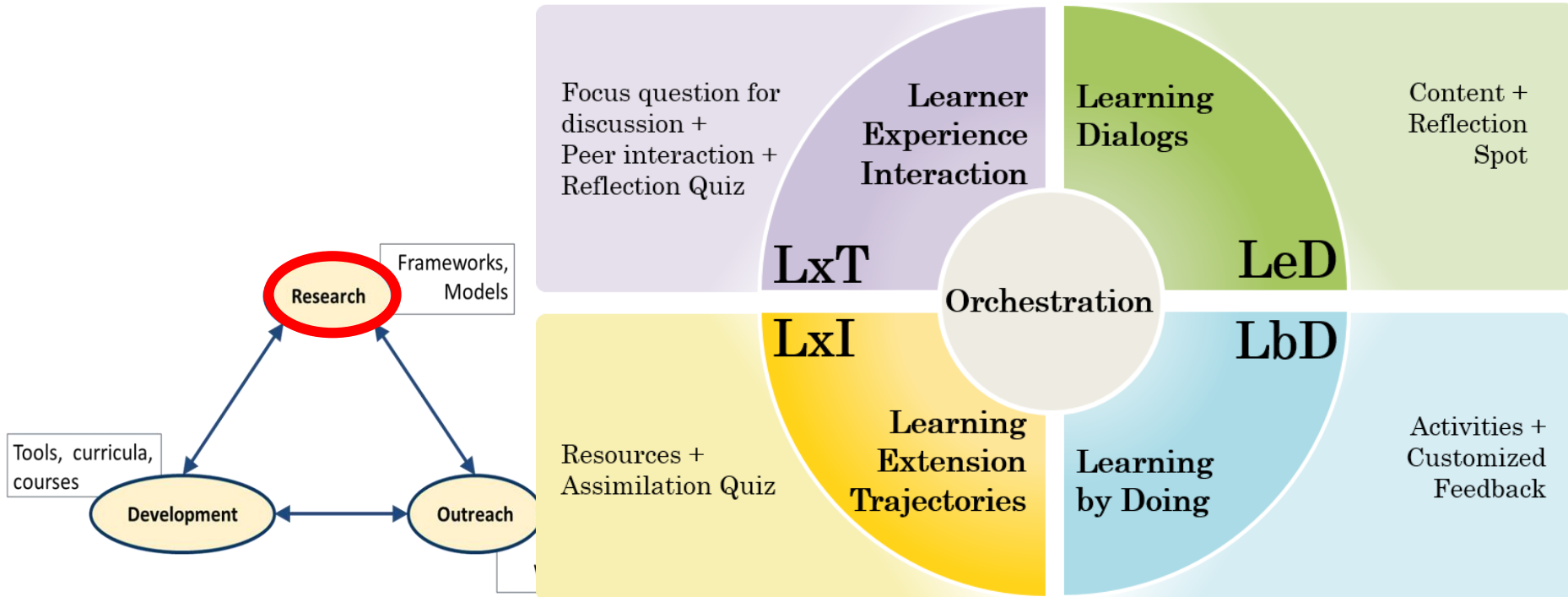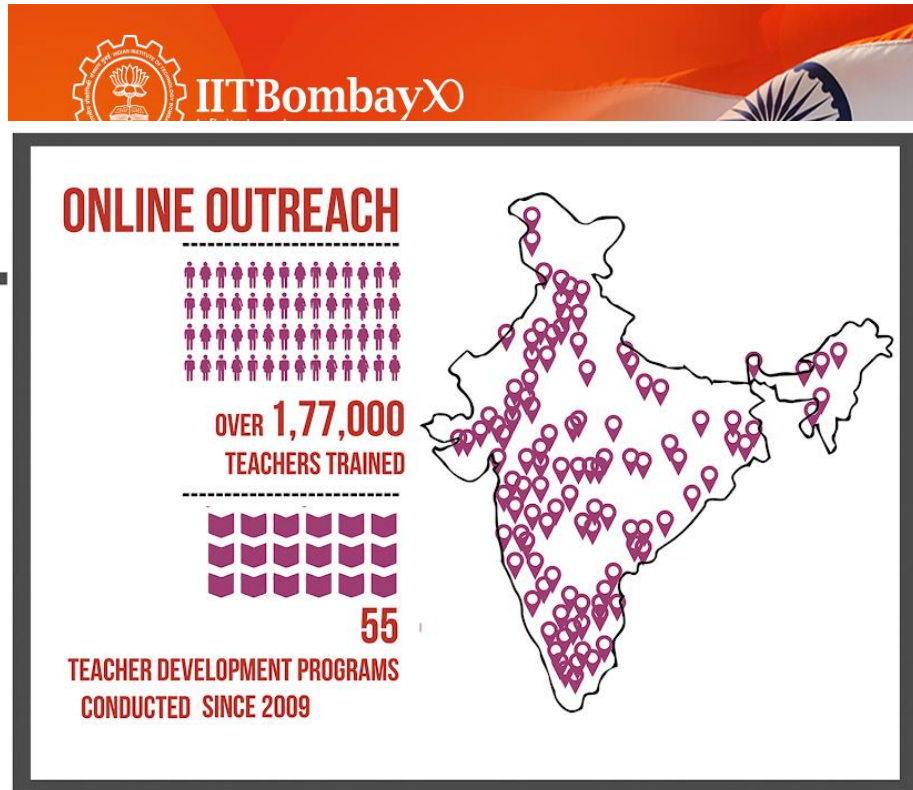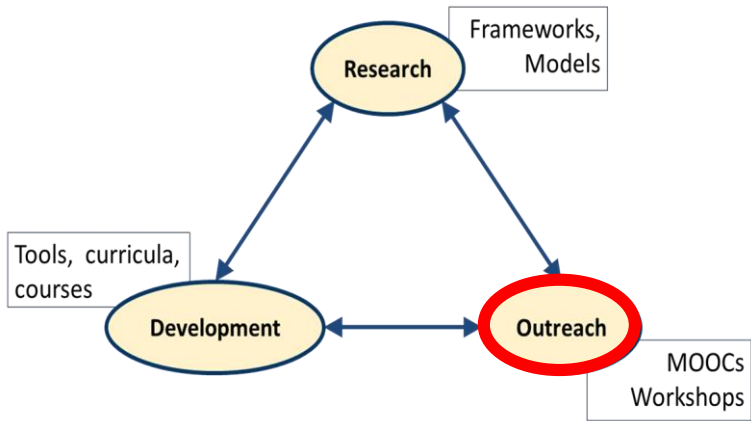Help Predict Graph

Scratchpad

Reset

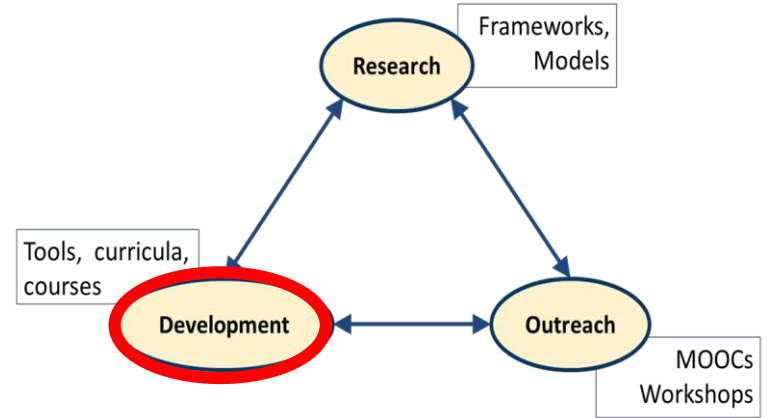## Learner-Centric MOOC (LCM) Model

# Research area: Teacher use of educational technology

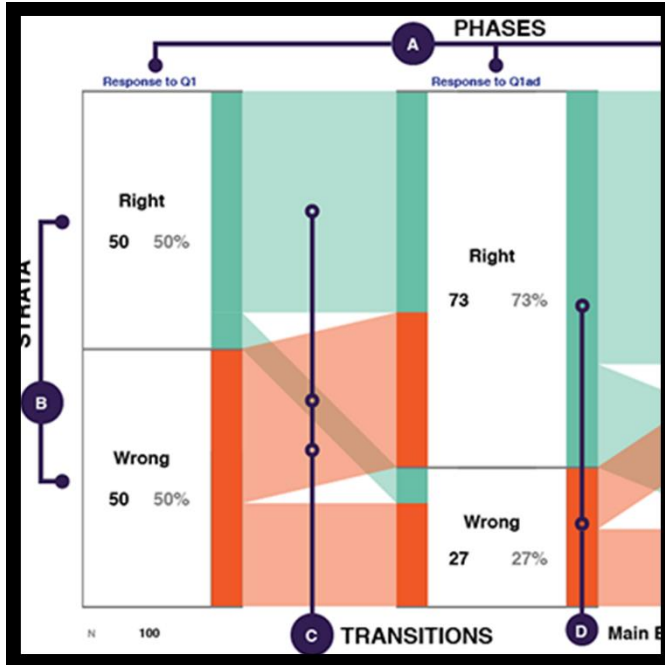**iSAT: Interactive Stratified Attribute Tracking**

GSR

Eye tracker

Portable EEG

Emotion Recognition

Cognition

Metacognition

Motivation

Affective States

Attention!

Learner/ User Model

Personalized and Adaptive Feedback
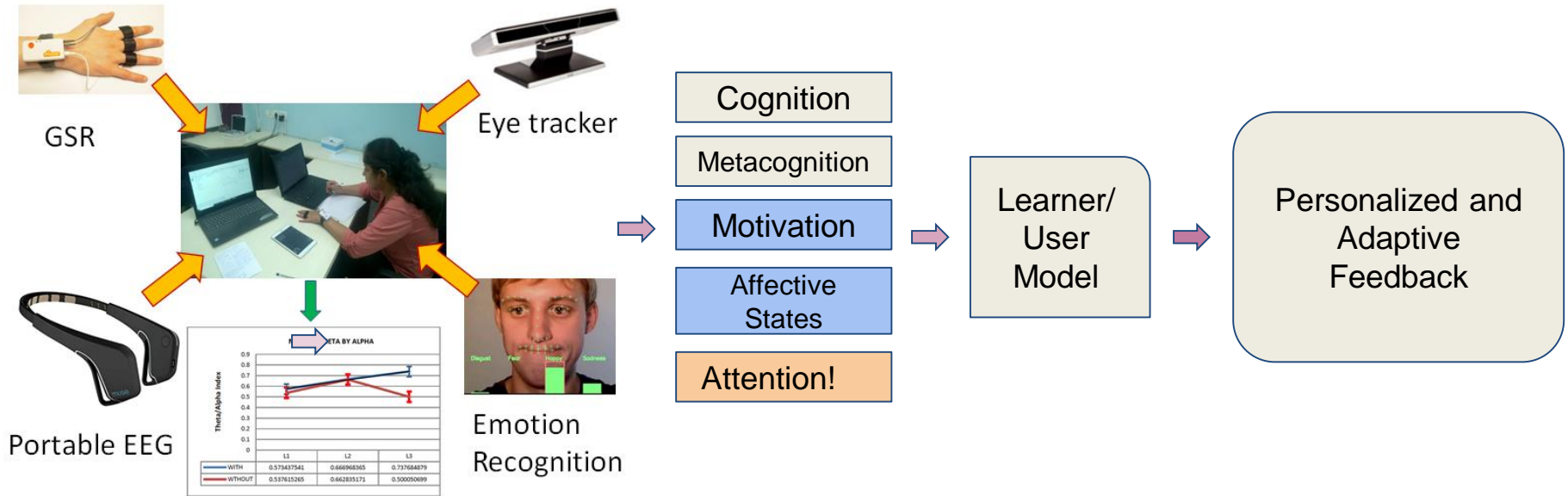
# Emerging Technologies



Wearables



Augmented Reality



3D Visualization

# How engaged are your learners?

# How engaged are your learners?

- Assume f2f setting.
- Imagine you are teaching a large group of trainees.

  *(how many? who? what kind of training?)*

- Imagine a 60-min session, large auditorium, fixed seats.

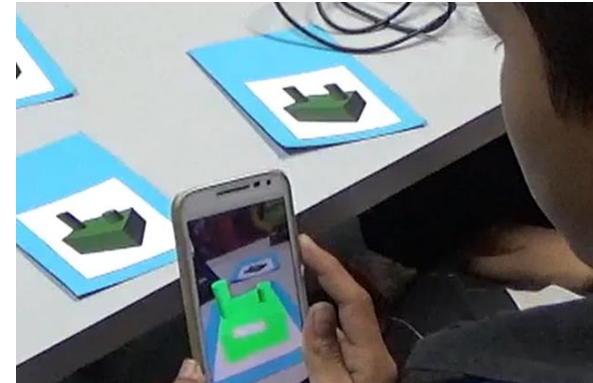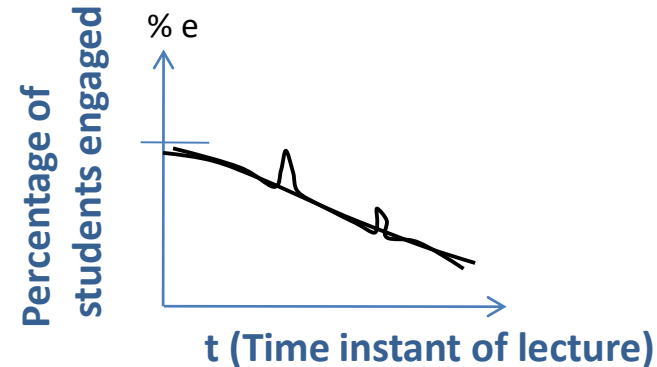# How engaged are your students?

- Imagine you are teaching a large group of trainees.
- Imagine a 60-min session in a large auditorium with fixed seats.

Think (Individually):

- Predict the percentage of students showing "engaged" behaviour (with the content), at various points of time.
- Draw a graph of engagement vs time. [~1 min]

# How engaged are your students?

Imagine you are teaching a large group of trainees.

Imagine a 60-minute class in a large auditorium with fixed seats.

Think (Individually):

Predict the percentage of students who may be showing "engaged" behaviour (with the content of the lecture), at various instants of time. Draw a graph of engagement versus time. [~1 min]

## Pair (with your neighbour):

- Examine each other's graphs.
- Together, come up with two techniques that could be used to convert your graph into something like the figure.  [~2 min]

# How engaged are your students?

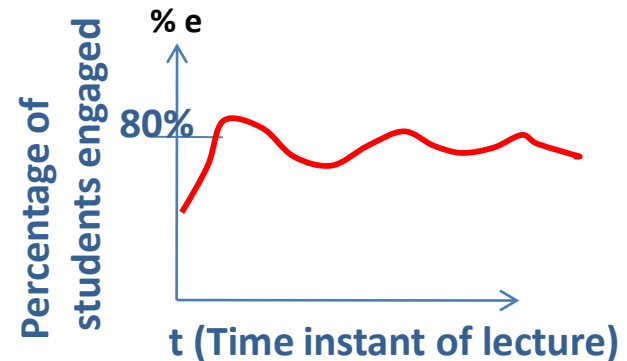Imagine you are teaching a large group of trainees.

Imagine a 60-minute class in a large auditorium with fixed seats.

Think (Individually):

Predict the percentage of students who may be showing "engaged" behaviour (with the content of the lecture), at various instants of time. Draw a graph of engagement versus time. [~1 min]

Pair (with your neighbour):

Together, come up with two techniques to convert your graph into something that looks like the figure.

## Share (entire audience):

- Share pros and cons of some techniques. [~2 min each]
- Identify top three techniques that are likely to "succeed". [~3 min]

Share (entire audience):

**% e**

**80%**
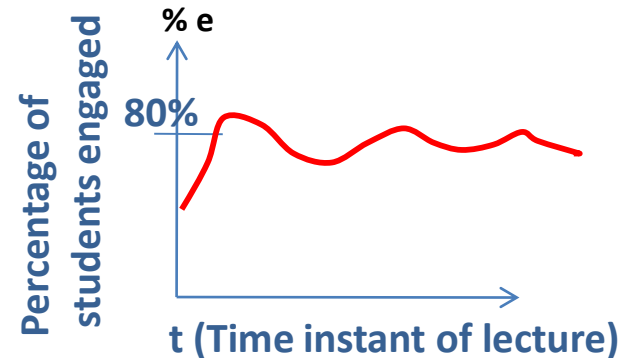
**t (Time instant of lecture)**
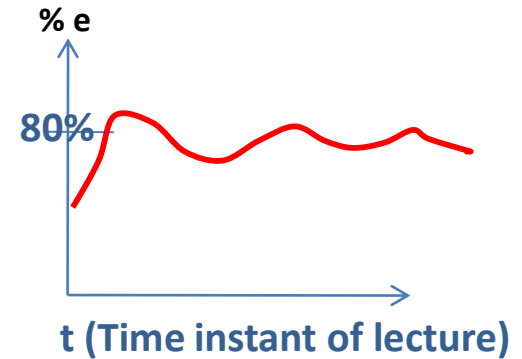
# Can we engage learners by

- Telling jokes?

  *- only during the joke ☺*

- Giving real life context? Historical anecdotes?

  *- necessary, good motivation, but again can do 1-2 times per topic*

- Asking – "do you have any doubts?"

  *- necessary, might results in 'blips' in engagement curve*

- Asking a question related to the topic

  *- necessary, might results in 'blips' in engagement curve*

# How can we maintain learner engagement?

ACTIVE LEARNING

# Requirements of active learning strategies

- Instructor designs activities that <u>requires</u> learners to talk, write, reflect and express their thinking.

- <u>Majority</u> of learners go beyond listening, copying of notes, execution of prescribed procedures.



- Explicitly based on theories of learning.

- Evaluated repeatedly through empirical research.

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

# But my lectures are plenty interactive!

Your colleague:

*"I often pause to ask my students if they understood the material. And I even allow them to interrupt whenever they have doubts."*

VOTE – Is this active learning?

1) Yes
2) No

# Recall - Requirements of active learning

- Instructor designs activities that <u>requires</u> learners to talk, write, reflect and express their thinking.

- <u>Majority</u> of learners go beyond listening, copying of notes, execution of prescribed procedures.

- Explicitly based on theories of learning.

- Evaluated repeatedly through empirical research.

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

# But my lectures are plenty interactive!

Your colleague:

*"I often pause to ask my students if they understood the material. And I even allow them to interrupt whenever they have doubts."*

VOTE – Is this active learning?

1) Yes
2) No

# Why interactive lectures may not be enough

- Students don't pay utmost attention throughout the lecture.

- Students *think* they understand since they can follow the lecture.

- Difficult to ensure that all students in the class participate actively.

- Students have a barrier to responding directly to the instructor.

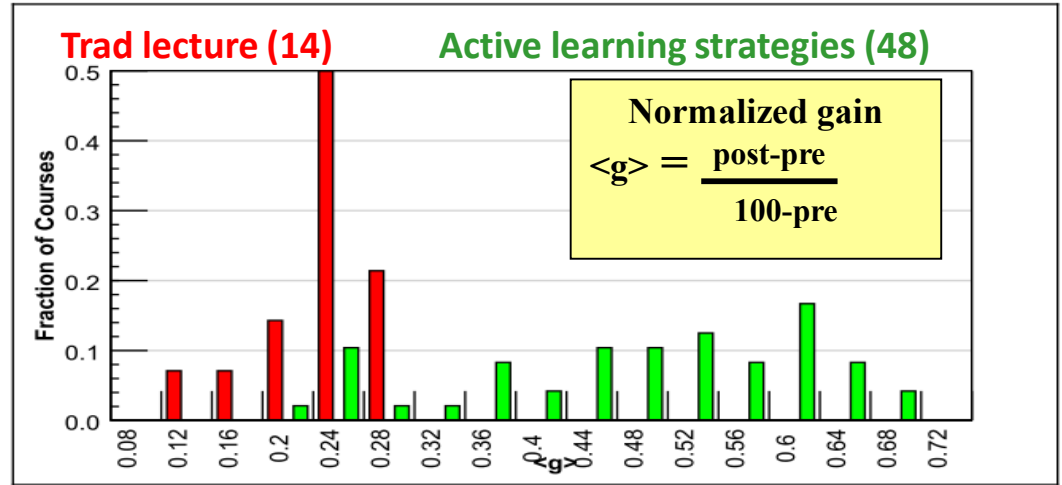But … is there data? Evidence?
Let's examine some empirical results.

# Evidence for active learning - 1

**Comparative study of 62 Physics courses (1998)**

- 6542 students
- Variety of institutions: high school, college, university
- Test of conceptual reasoning
  – Force Concept Inventory
- Pre-post, semester long

**IMPLICATION**

Desirable to explicitly incorporate active learning strategies in our teaching & training.



**Trad lecture (14)**     **Active learning strategies (48)**

Normalized gain

$$\langle g \rangle = \frac{\text{post-pre}}{100\text{-pre}}$$

RESULTS:
- Maximum gain from lecture courses : 0.28
- Gain from active-learning courses : 0.23-0.7

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)

# Evidence for active learning - 2



**Active learning increases student performance in science, engineering, and mathematics**

Scott Freeman[a,1], Sarah L. Eddy[a], Miles McDonough[a], Michelle K. Smith[b], Nnadozie Okoroafor[a], Hannah Jordt[a], and Mary Pat Wenderoth[a]

[a]Department of Biology, University of Washington, Seattle, WA 98195; and [b]School of Biology and Ecology, University of Maine, Orono, ME 04469

Edited* by Bruce Alberts, University of California, San Francisco, CA, and approved April 15, 2014 (received for review October 8, 2013)

To test the hypothesis that lecturing maximizes learning and course performance, we metaanalyzed 225 studies that reported data on examination scores or failure rates when comparing student

225 studies in the published and unpublished literature. The active learning interventions varied widely in intensity and implementation, and included approaches as diverse as occasional group

## Meta-analysis of 225 studies (2014)

- Exam performance: higher by 0.47 standard deviations in active learning courses– ~ 1/2 letter grade average increase.

- Failure rates :  33.8% in traditional classes vs 21.8% in active learning courses

- Results hold across STEM disciplines, majors and non-majors, lower- and upper-division courses.

- Effect sizes greater for concept inventories than for instructor-written exams.

(hint – you've already seen two examples ☺ )
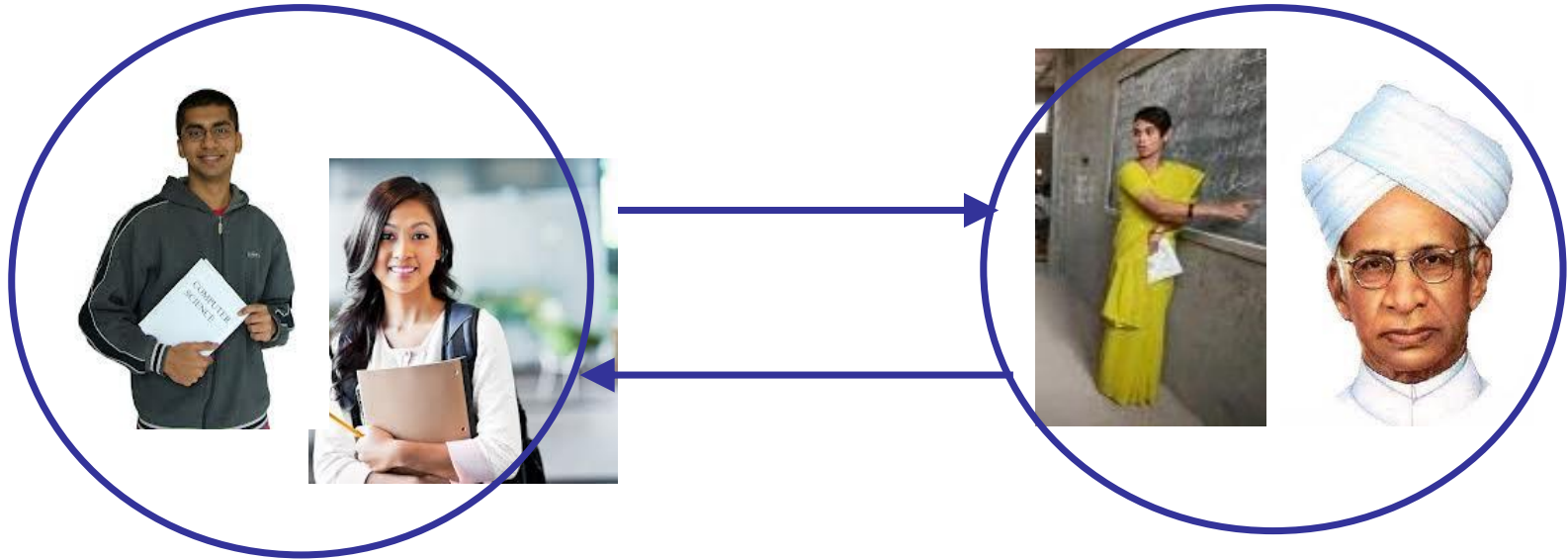
# Vote individually

# Vote individually

You toss an old 1-rupee coin and a new 1-rupee coin. Which outcome is most likely:

1) Two heads

2) Two tails

3) One head and one tail

4) Each of 1, 2, 3 above is equally likely

You toss an old 1-rupee coin and a new 1-rupee coin. Which outcome is most likely:

1) Two heads

2) Two tails

3) One head and one tail

4) Each of 1, 2, 3 above is equally likely

You toss an old 1-rupee coin and a new 1-rupee coin. Which outcome is most likely:

1) Two heads

2) Two tails

3) One head and one tail

4) Each of 1, 2, 3 above is equally likely

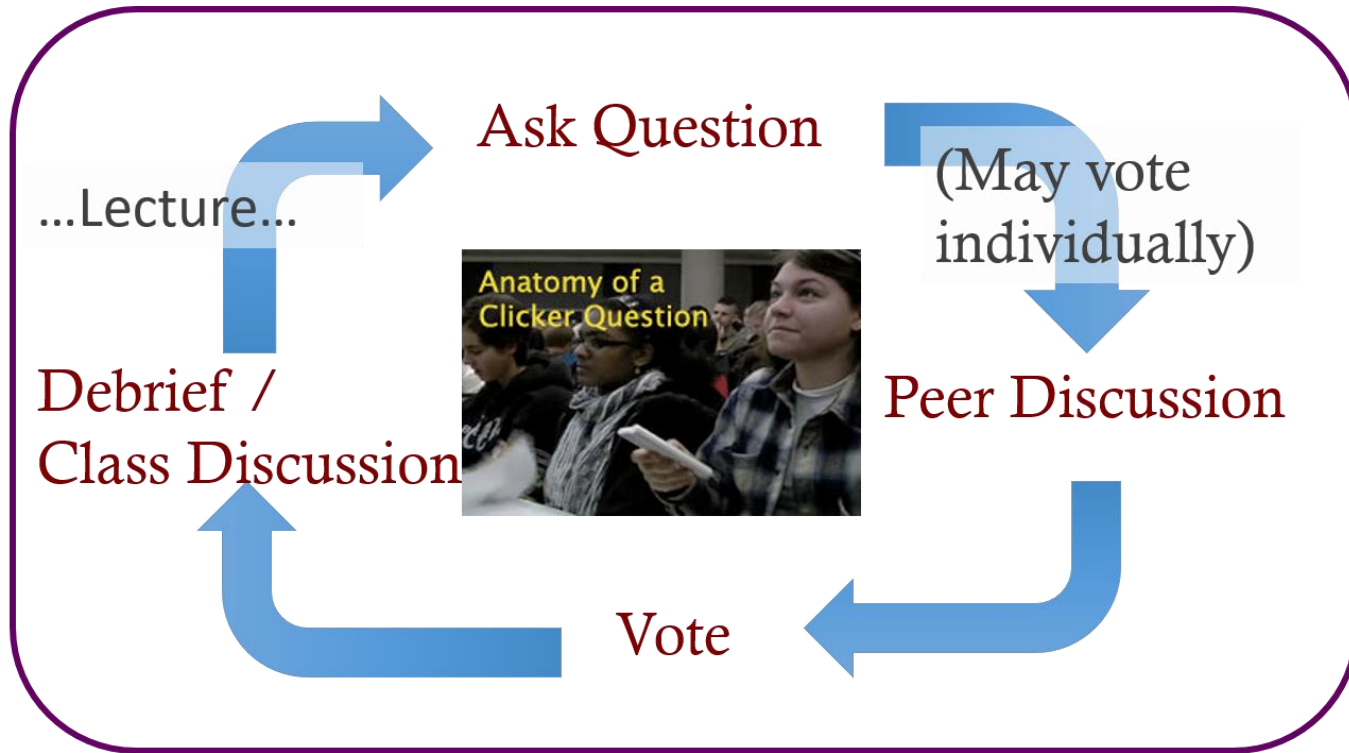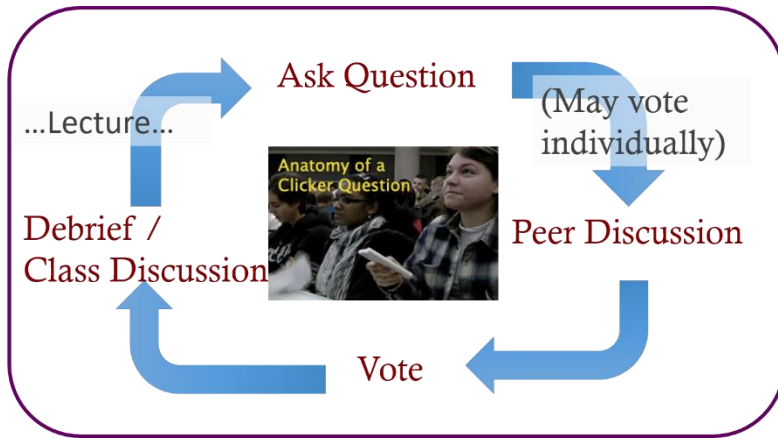# DISSECTING PEER INSTRUCTION FURTHER



...Lecture... → Ask Question → (May vote individually) → Peer Discussion → Vote → Debrief / Class Discussion

Anatomy of a Clicker Question
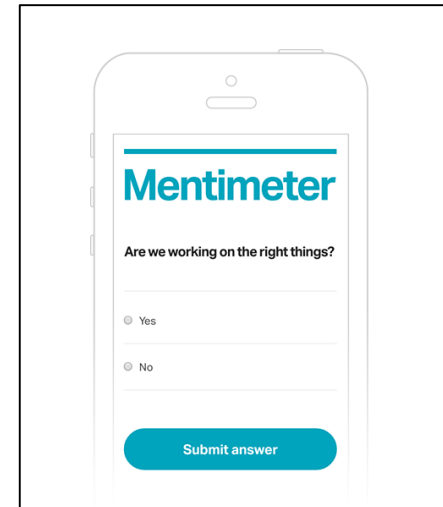
1) Which step should never be skipped?

2) How much time to spend?
3) How often to do?

4) What if ... too quiet? Too noisy?

5) Which is the most challenging step?

# Implementing peer instruction
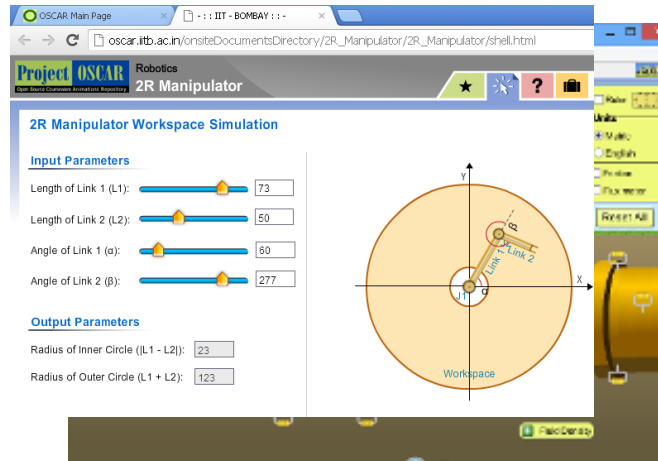
# Implementing PI with technology
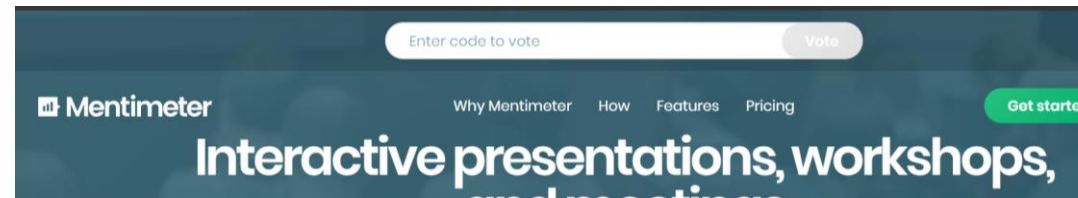
# Your opinion on videos & animations

Visualizations such as animations and simulations have been shown to provide many learning benefits.

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



Vote - [www.mentimeter.com](www.mentimeter.com)



Use code 41464

# Research from use of visualizations

- Showing demo alone is not effective  (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).

# Research from use of visualizations

- Showing demo alone is not effective (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 of the visualization

  (Laasko et al 2009; Windschitl & Andre 1998, Banerjee, Murthy & Iyer 2015)

A helium balloon is attached to a string tied to the bottom of a cart on wheels. The sides of the cart are encased in clear plastic. A person will abruptly push the cart to the left.



Will the balloon move?

1) Yes, to the left

2) Yes, to the right

3) No

A helium balloon is attached to a string tied to the bottom of a cart on wheels. The sides of the cart are encased in clear plastic. A person will abruptly push the cart to the left.

# Your ideas – visualization + Peer instruction

# How to write Peer Instruction questions

A 'good' PI question:

- Is usually conceptual, requires thought
  - Avoid recall level Qs
  - Avoid long calculation

- Should elicit pre-existing thinking

- Asks learners to predict results
- Make learners apply to new context

- Has believable distractors
- Is not ambiguous, leading or 'trivial'

# What makes Peer Instruction work?

LEARNERS:

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

TEACHERS?

# Active learning strategies for f2f setting

- Peer-Instruction

- Think-Pair-Share

- 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 programming
  - (tutorial) TPS, TPS, Problem-based learning, case-based learning

# Recommendations for f2f training

*Make learners grapple with ideas* during *the training session.*

Don't just clarify doubts.

Use proven active learning strategies.

Require learners to debate, apply, articulate – not just recall.

# What if I want to move to online training?

# What if I want to move to online training?

Myth or Reality?

An e-learning module or MOOC is mostly uploading videos on a LMS.

# What if I want to move to online training?

*Myth:*

An e-learning module or MOOC is mostly uploading videos on a LMS.

*Reality:*

An e-learning module or MOOC needs to be <u>learner-centric</u>.

# What if I want to move to online training?

*Myth:*

An e-learning module or MOOC is mostly uploading videos on a LMS.

*Reality:*

An e-learning module or MOOC needs to be <u>learner-centric</u>:

- Attention to learner motivation
- Opportunities for immediate micro-application
- Formative assessment and instant feedback
- Explicit activities to foster peer-learning
- Ensure learner connect

# What if I want to move to online training?

Myth or Reality?

A fluent video is more effective than a disfluent video.

Fluent - instructor speaks confidently, eye-contact
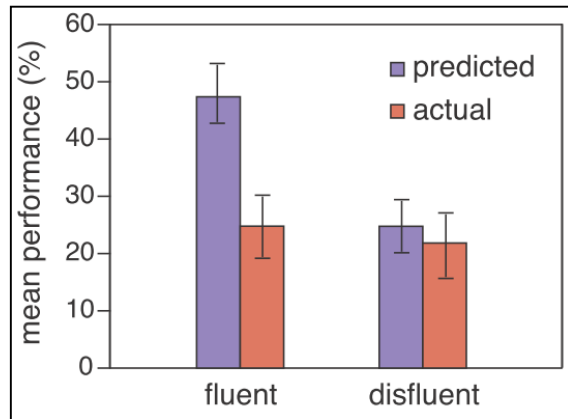Disfluent – instructor speaks haltingly, slouches, poor body language

*Myth:*

A fluent video is more effective than a disfluent video.

*Reality*:



RESULTS

1) Both groups: *Same actual learning*

2) Fluent video: Perceived learning greater than actual learning

3) Disfluent video: Perceived learning equal to actual learning

# What if I want to move to online training?

*Myth:*

Using the new & exciting technology – VR, Cloud, AI – is necessary in today's setting.

*Reality:*

Sophisticated pedagogy + routine technology
trumps
Advanced technology + mediocre pedagogy

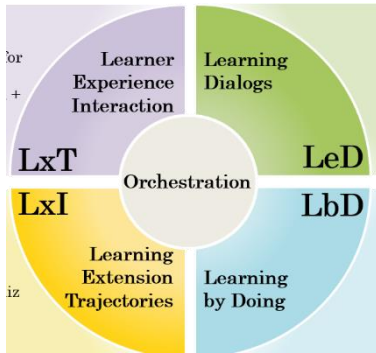# Recommendations for online training

## Use a blended approach

Flipped classrooms

Blended MOOCs

VC, Webinars, Hangouts …

…

## Follow LCM model



Insert a micro-activity within the video

Follow every video with question(s) + feedback

Address learner diversity via extension trajectories

Cultivate peer learning via experience interaction

# What can we do for organizations?

- Consultancy
  - Multimedia content creation, instructional design
  - Curriculum redesign, development of training programs
  - Benchmarking / Evaluation of educational content and implementation

- Training (CEP)
  - Incorporation of learner centric pedagogy in training
  - Creation of blended courses and MOOCs

- Sponsored Projects: various R&D projects in educational technology

- Industries worked with so far: InOpen, Next Education, NIETT, MTNL

# THANK YOU

For more info:
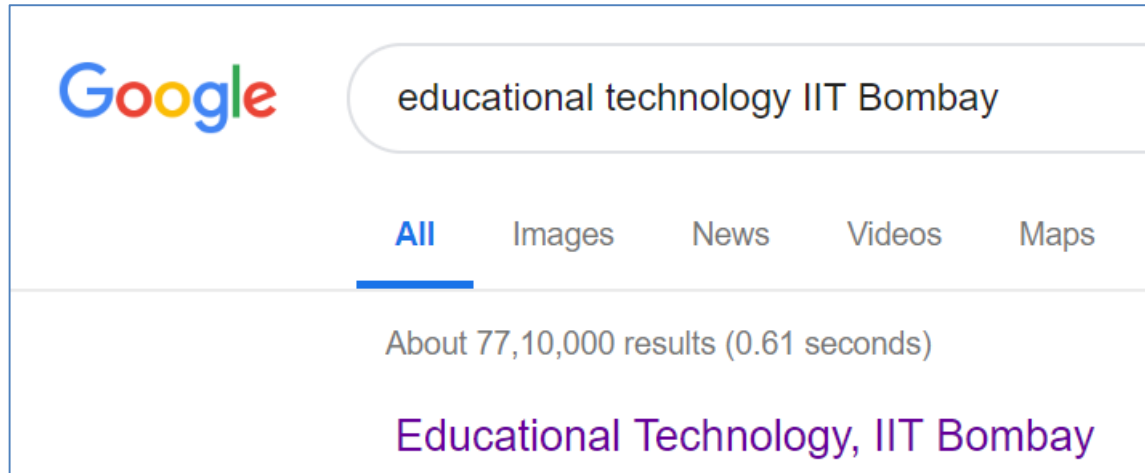


www.et.iitb.ac.in

sahanamurthy@iitb.ac.in