

**QEEE Workshop**  
**Pedagogy for Effective Use of ICT in**  
**Engineering Education**



**IIT Bombay**  
**June-July 2014**

# Flipped Classroom

# Scenario

Consider two teachers A and B, for a given topic. Teacher A gives a lecture on the topic in-class, followed by problem-solving exercises for the students to practice at home.

Teacher B asks students to watch a video of the lecture at home **before** coming to class, and does problem-solving activities in-class.

# **Activity - Debate (10 minutes)**

Coordinators: Make 2 groups - A and B.

Participants:

Those in group A should list points for why Teacher A's strategy is "better" than Teacher B.

Those in group B should list points for why Teacher B's strategy is "better" than Teacher A.

Coordinators: Send two main points in favour of Teacher A and two points for Teacher B, through A-view chat.

# Summary – Teacher A

Teacher A: Lecture in-class + Exercises at home.

- Teacher's perspective – Can adapt lecture dynamically to students' response.
- Student's perspective – Can ask questions to teacher during class.
- Key drawback – Student does not have access to teacher while working on problems at home. Teacher does not know what difficulties students face while doing problem solving.

# Summary – Teacher B

Teacher B: Video at home + Exercises in-class.

- Teacher's perspective – Can address students' problem-solving difficulties **in-class**.
- Student's perspective –
  1. Can watch lecture video at own pace.
  2. Can get immediate help from peers and teacher during problem-solving.
- Key drawback – Teacher effort to create the video.

# Learning objectives of this session

At the end of this session, you will be able to:

- Describe what is flipped classroom and its advantages.
- Identify some active learning strategies to effectively integrate flipped classroom in your teaching.

Lab:

- State guidelines to create videos for a flipped classroom.
- Design active learning strategies for your course while teaching with flipped classroom videos.

# Reflect - A typical traditional classroom

## During class – Information transmission

- Instructor lectures, Students take notes.
- Instructor asks questions, Students respond.
- Students ask questions, Instructor responds.

## Outside class – Assimilation

- Instructor gives problem sets and assignments, Students solve and submit.
- Students may work individually or in groups.



# Limitations of a traditional classroom - 1

- During class - Information transmission
- Instructor lectures:
  - Students don't pay utmost attention; Students assume they understand because they can follow the lecture
- Instructor asks questions:
  - Often answered only by few (high-achievers)
  - Others are left behind
- Students ask questions:
  - Often asked only by few (high-achievers)
  - Instructor assumes that all students have understood

# Limitations of a traditional classroom - 2

- Outside class - Assimilation
- Instructor gives problem sets and assignments
  - may be too challenging for some students, or too boring for others, possibly lead to copying of answers.
- Students study individually or in groups
  - typically happens just before assignment submission deadline or exam.
  - may focus on assessment, not on concept attainment.

# Flipping the classroom - From

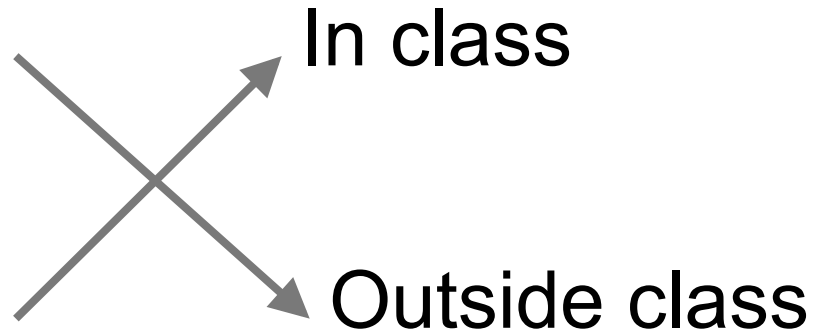
Information Transmission  In class

Assimilation  Outside class

# Flipping the classroom - To

Information Transmission

Assimilation



# Flipped classroom - What is it?

Flipped classroom is one way to ensure that class time is spent in assimilation, rather than in information transmission.

- Instructor finds or creates videos on topic.
- Students watch video **before** coming to class.
- Class time is spent in activities and discussions.

# Flipped classroom - Videos

- 10-20 minutes of 'lecture' on one concept.
- Video may include slides, audio, annotation, writing on surface, screen capture of an app.

## Examples:

- See videos posted on <http://flippedlearning.org>
- KhanAcademy, OCW, NPTEL, SpokenTutorials
- Watch now – Pythagoras Theorem video
- [https://www.khanacademy.org/math/geometry/right\\_triangles\\_topic/pyth\\_theor/v/pythagorean-theorem](https://www.khanacademy.org/math/geometry/right_triangles_topic/pyth_theor/v/pythagorean-theorem)

# Flipped classroom - Activities

- Content is given context (real-world scenarios).
- Students are actively engaged in problem solving and critical thinking beyond the traditional course.
- Students are encouraged to ask exploratory questions and delve beyond core curriculum.
- Students are transformed from passive listeners to active learners.

# Recall - What is active learning?

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

## Benefits:

- Students are actively engaged, and learn from each other.
- Builds a friendly, yet academic atmosphere.
- Includes all the students in the teaching-learning process.



# Flipped classroom and Active learning

Classroom with instructor and peers present is more useful for students to apply their learning, rather than listening to information transmission and asking clarifications.

In a flipped classroom, the in-class time can be devoted to tasks that promote active learning, since information transmission happens before class.

# Flipped classroom - Does it work?

There are many studies establishing the benefits of active learning strategies. Flipped classrooms that incorporate active learning reap these benefits!

- Flipped classroom with Peer Instruction results in significant learning gains compared to traditional instruction (Mazur 2001).
- Flipping the classroom with small group discussions can produce significant learning gains (Weiman 2011).

## Summary - Why is flipped classroom a good idea?

- Class time is spent in assimilation, rather than information transmission.
- Class time is spent in higher cognitive levels (apply, analyze, create), rather than lower levels (recall, understand).
- Support of peers and instructor is available **while** working on higher cognitive levels.

# Activity - Think-Pair-Share

Suppose your institute made it compulsory for you to use the flipped classroom mode. You found an excellent video on your topic and asked your students to watch it before class.

Think: What will do in class (most of the time)? Write down your individual answer. Do not simply say “I will do problem-solving”. Be specific about what will happen during the activity (~2 minutes).

# Activity - Think-Pair-Share

Suppose your institute made it compulsory for you to use the flipped classroom mode. You found an excellent video on your topic and asked your students to watch it before class.

Think: What will do in class (most of the time)?

Write down your individual answer. (~2 minutes).

Pair: Examine your neighbour's answer. Does it help students to work on higher cognitive levels?

Together, make your answers more specific so that your strategy develops the higher cognitive levels of your students (~5 minutes).

# Activity - Think-Pair-Share

Think: What will do in class (most of the time)?

Write down your individual answer. (~2 minutes).

Pair: Together, make your answers more specific so that your strategy develops the higher cognitive levels of your students (~5 minutes).

Share: Share your answer with your colleagues.  
(~5 minutes).

Coordinators: Share the most common answer through A-view chat (~2 minutes).

# Flipped classroom – Example 1

Course: Computer Programming; Topic: Arrays

Pre-class activity – Watch a video that defines an Array and shows C++ examples on using arrays.

In-class activities:

1. Worksheet having programs using arrays, where the students have to predict the output of some, find errors in others, and insert missing code.
2. Think-Pair-Share to write a program to sort an array.

# Flipped classroom – Example 2

Course: Communication Networks; Topic: IP Addressing

Pre-class activity – Watch a video that describes a basic mechanism for assigning IP addresses in a network.

In-class activities:

1. Peer Instruction questions on IP address classes.
2. Debate pros and cons of hierarchical addresses.
3. Think-Pair-Share to design solutions to reduce inefficient use of address space.



# **Alert - A flipped classroom is NOT**

- Instructor simply creating lecture videos.
- Students simply watching lecture videos.
- Instructor simply giving clarifications in class.

The instructor needs to create structured learning activities, to be carried out in-class, for students to apply what they learned from the videos.

# Flipped classroom - Key elements

1. Give students an opportunity to gain first exposure to the topic before class.
2. Provide incentives for students to prepare for class.
3. Facilitate higher level cognitive activities in the classroom.
4. Provide mechanisms for students to get feedback from peers and instructor.

# Activity: Create activities for flipped classroom

1. Form groups of 3.
2. Watch the video called “Pythagorean theorem” from Khan Academy: [https://www.khanacademy.org/math/geometry/right\\_triangles\\_topic/pyth\\_theor/v/pythagorean-theorem](https://www.khanacademy.org/math/geometry/right_triangles_topic/pyth_theor/v/pythagorean-theorem) (first video). Watch only 0.00 – 4.30.
3. Assume students have watched this video before coming to class.

# Activity: Create activities for flipped classroom

Given below are 2 learning objectives in the topic of Pythagoras theorem. For each objective, design an activity that you will do in the classroom.

Make sure your activities involve some form of active-learning, that is you do more than explaining and demonstrating, and your students go beyond watching and writing notes.

- i) Apply Pythagoras theorem to solve a real life problem involving distances.
- ii) Devise a geometrical proof of Pythagorean theorem.

Coordinators: Share 1-2 activities on A-view chat.

**Flipped classroom for your class**

# Guidelines (for pre-class)

1. From your next topic, choose a concept that will take about 10 minutes of “lecturing”.
2. Choose a format of pre-class activity for this concept. For example, you may find / create a video of the lecture, or you may assign some reading.

\* For finding a video, look at NPTEL, OCW, YouTube.

\* For creating your own video, do the next Lab activity.

# **Guidelines (for in-class)**

3. Decide what you will do to ensure that students do the pre-class work (Watch video or read). For example, you may give a simple quiz at the start of the class.
4. Create in-class activities that will help students to work on the topic at higher cognitive levels.
5. Ensure that students get feedback on their work, either from peers or you.

# Some effective in-class activities

- Peer Instruction questions - for ensuring conceptual understanding and addressing common misconceptions.
- Think-Pair-Share - for application of concepts and tackling design problems.
- Group problem-solving - for extension of concepts and tackling open-ended problems.



## **Create your own video – Lab activity**

Walk through Lab activity slides and instructions

## **Create your own flipped class – Online activity**

Preview of Moodle activity and assignment for next week

# References

<http://cft.vanderbilt.edu/guides-sub-pages/flipping-the-classroom/>

[http://ctl.utexas.edu/teaching/flipping a class/what is flipped](http://ctl.utexas.edu/teaching/flipping_a_class/what_is_flipped)

<http://flippedclassroom.com/>

<http://flippedlearning.org/>

“Flipped Classroom Field Guide” from coursera