Active Learning

Outline

- Methodology/Approaches
- ICT Tools

Why Active Learning?

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.

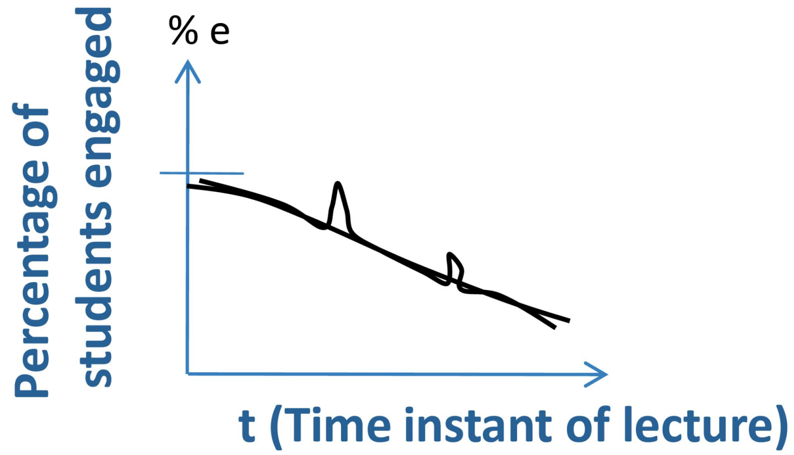
Why Active Learning?

How engaged are your learners?

- 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]



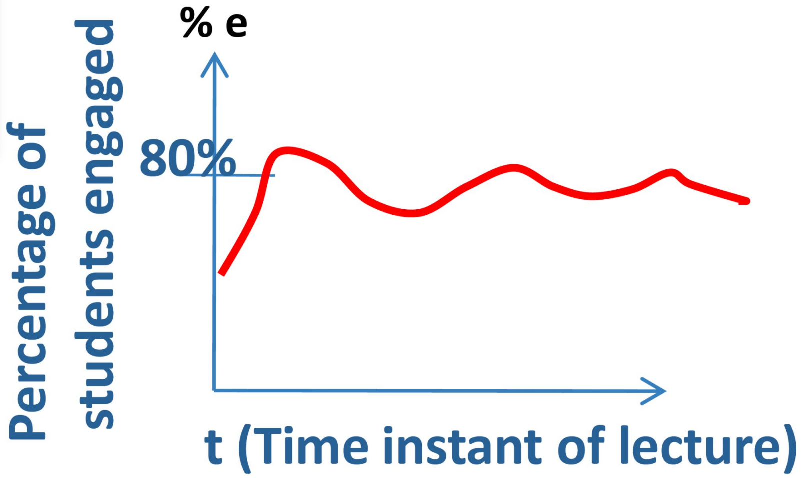
Why Active Learning?

How engaged are your learners?

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

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]



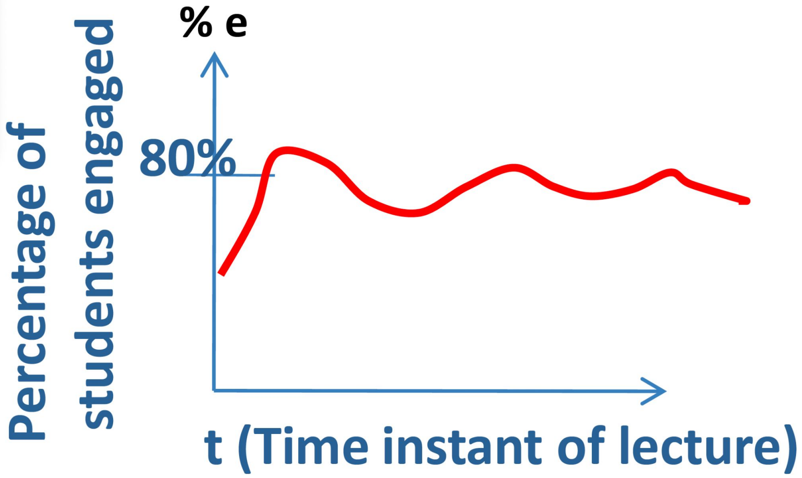
Why Active Learning?

How engaged are your learners?

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

Share (entire audience):

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

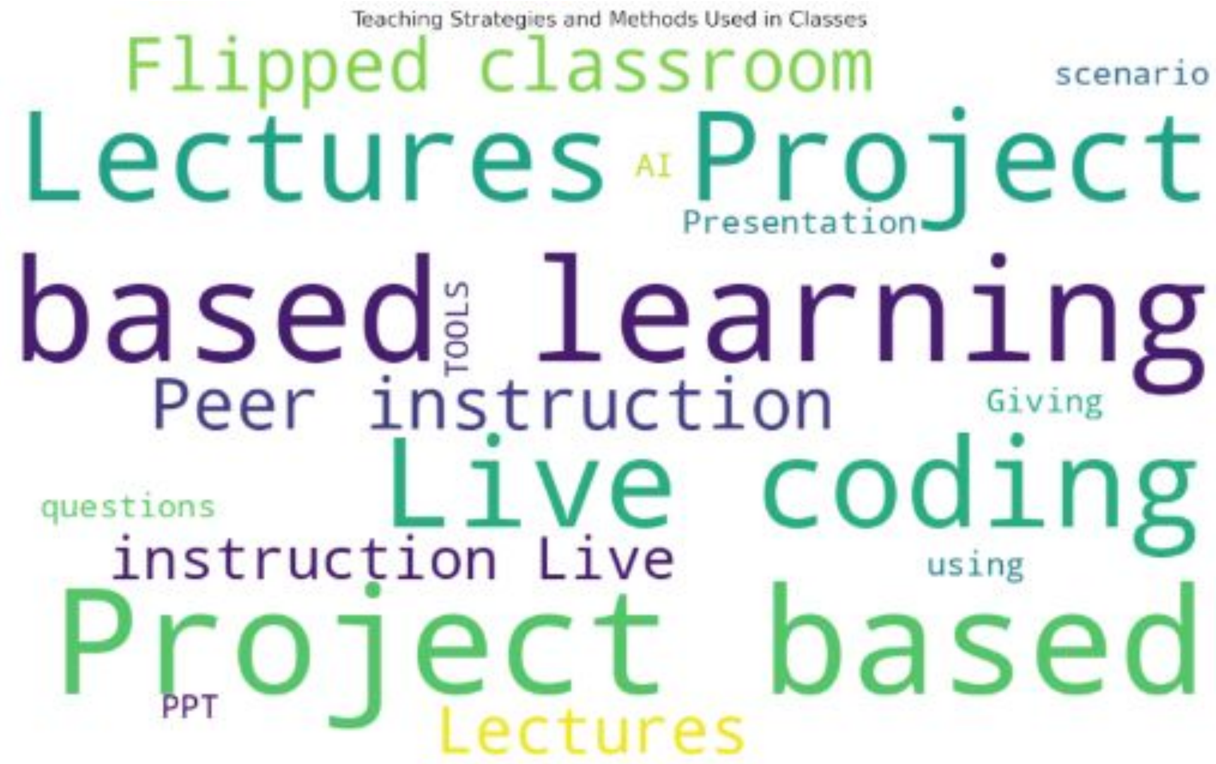


How engaged are your learners?

Share (entire audience):

- Q&A session
- Cracking a joke
- Gamified quiz or crossword (~1min)
- Relevant topic videos
- Actual outcome to class - LO, journey
- Animations - cue to get back
- MemesProblem solving - colab - team 4-5
- Flipped classroom - ed puzzle
- Short story
- Group formation - what they learnt from teacher

Can we engage the learners by



Can we engage the 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 strategies

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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.

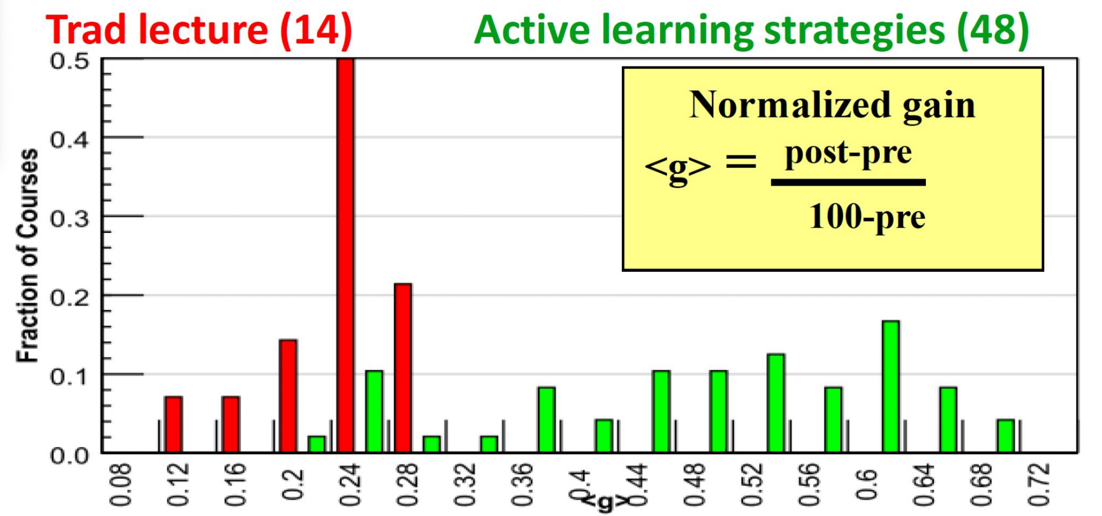
But ... is there data? Evidence?

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



Implications

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

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

PNAS

CrossMark
click for updates

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 performance in undergraduate science, technology, engineer-

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 problem-solving, worksheets or tutorials completed during class,

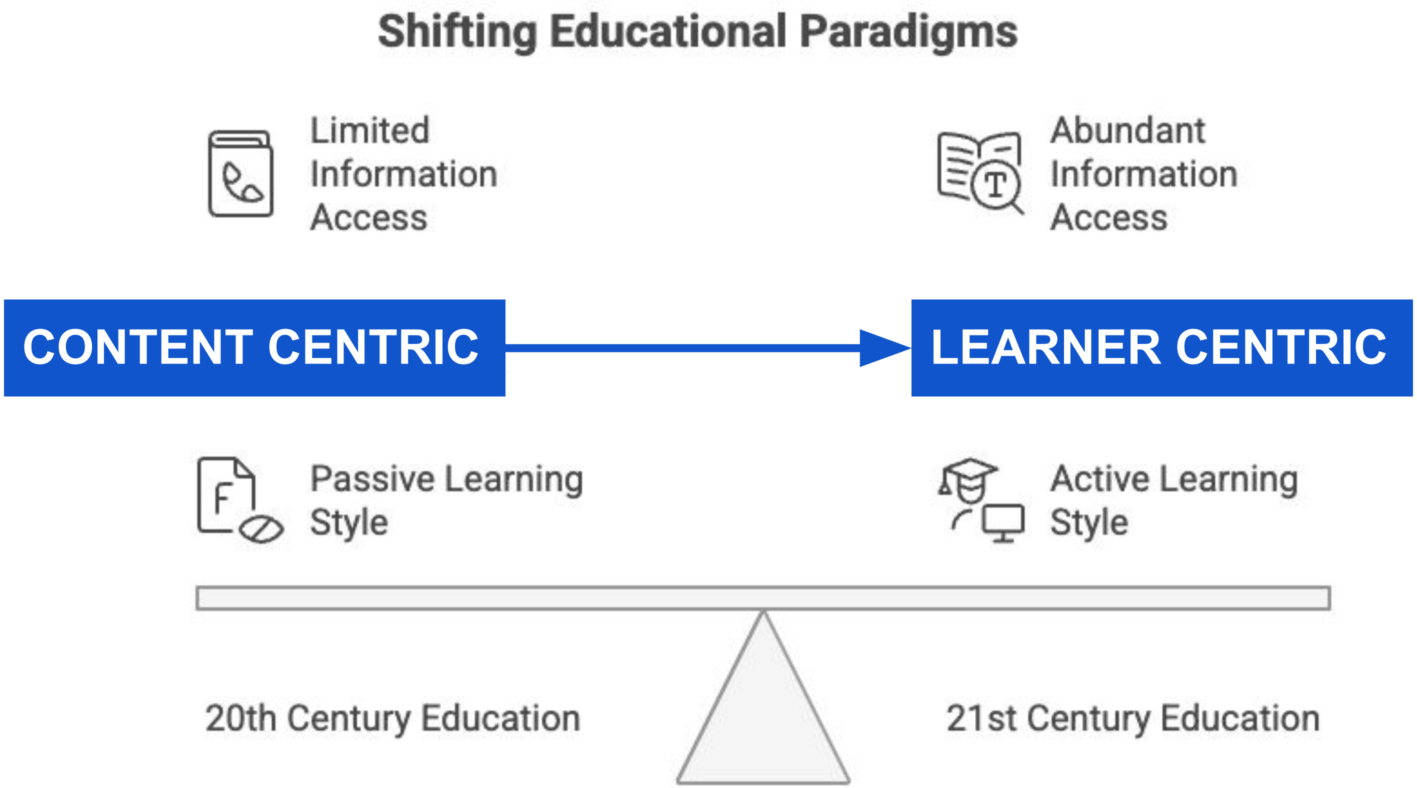
Meta-analysis of 225 studies (2014)

- 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.

How to implement active learning?

(hint - You’ve already seen two examples 😊)

How to implement active learning?



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 1, 2, 3 above is equally likely

Discuss with your neighbour and converge

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Vote again with group converged answer

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Vote again with group converged answer

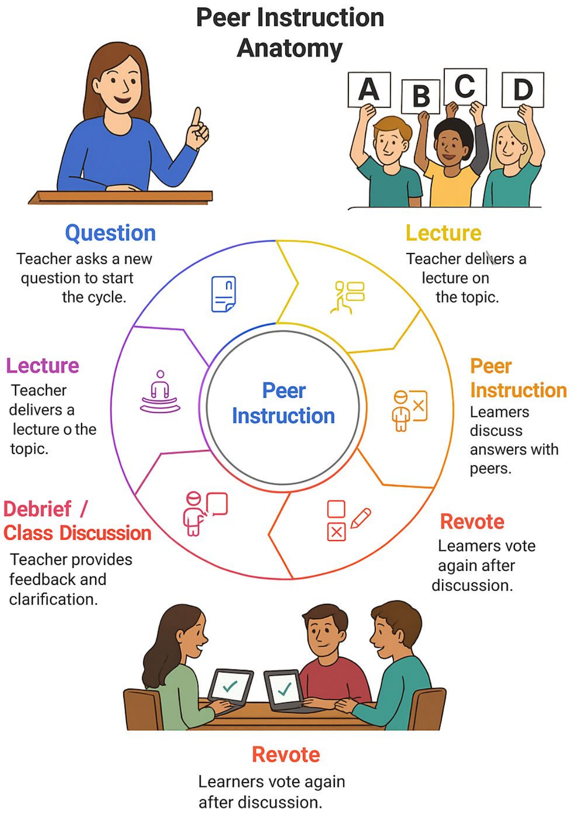
You toss an old 1-rupee coin and a new 1-rupee coin. Which outcome is most likely:

(H-H, T-T, H-T, T-H)

1) Two heads (¼)
2) Two tails (¼)
3) One head and one tail (½)
4) Each 1, 2, 3 above is equally likely

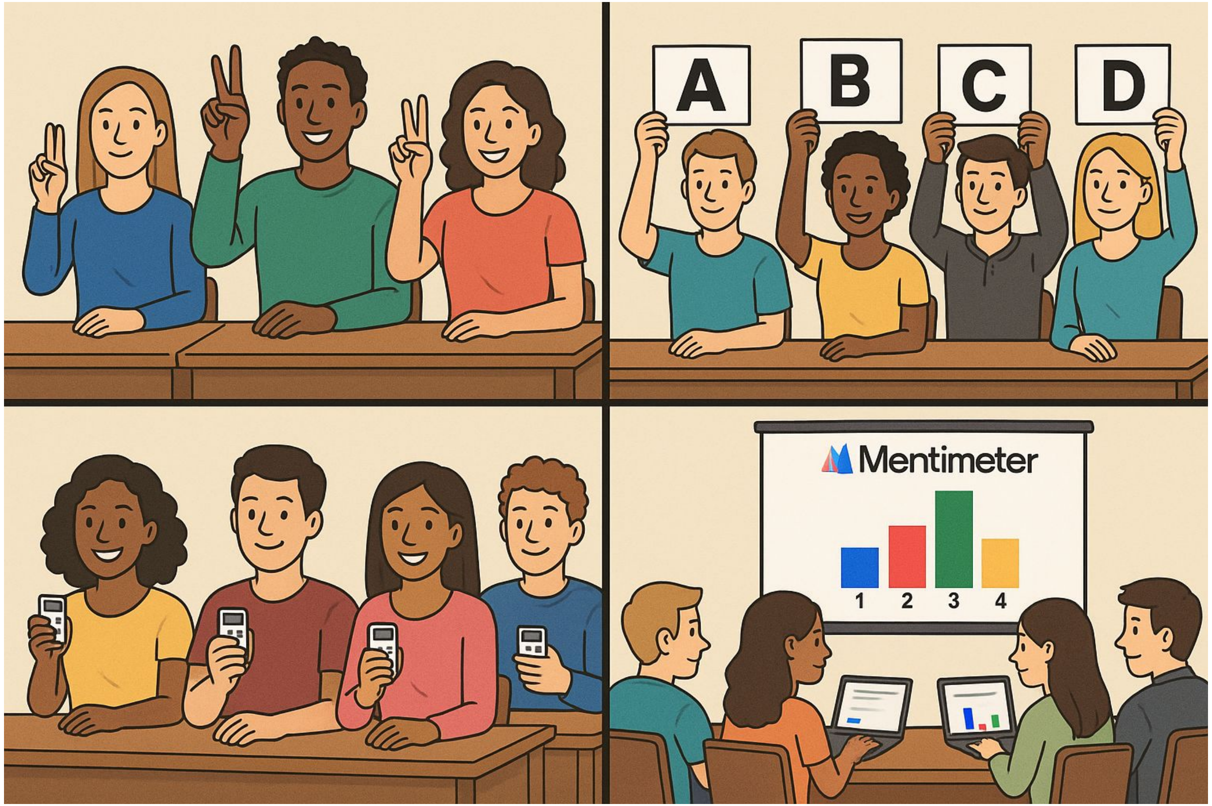
Anatomy of a peer instruction

Dissecting peer instruction further



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) The class will get chaotic, how do I get them back?

Implementing 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 prior knowledge

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

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

When to use PI within the learning cycle?

BEFORE	DURING	AFTER
Setting up instruction (beginning of module)	Developing knowledge (middle of module)	Assessing learning (end of module)

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Questions to

Motivate
Discover
Provoke thinking
Assess prior knowledge

Questions to

Check knowledge
Application
Analysis
Evaluation
Synthesis
Elicit Misconceptions

Questions to

Relate to big picture
Demonstrate success
Review or recap
Exit poll

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?

What makes peer instruction work?

TEACHERS:

- Anticipate common misconceptions ⇒ Helps design believable distractors
- Create time and space for peer discussion ⇒ Give time and permission to talk, reason, change minds
- Frame mistakes as opportunities ⇒ Normalize confusion, promote risk-taking
- Use data (votes/discussions) to diagnose understanding ⇒ Real-time formative assessment
- Encourage a culture of participation ⇒ Everyone contributes—whether sure or unsure

Writing effective Peer-Instruction questions - Example 1

Below is the for loop for calculating the factorial of a number. How many times is this set of code executed?

```
for (i = 1; i <= N; i ++) {
nFactorial = nFactorial * i;
}
```

1) 1 time
2) N times
3) N-1 times
4) N+1 times

Writing effective Peer-Instruction questions - Example 2

What is the output of the code shown below?

```
int main() {
int a = 1; b = 2; c = 3;
int *p, *q;
p = &a; q = &b;
c = *p; p = q;
*p = 13;
cout << a << b << c;
}
```

1) a=1, b=2, c=3
2) a= 1, b=13, c=1
3) a=1, b=2, c=1

Writing effective Peer-Instruction questions - Example 3

What does this code do?

```
main () {
int vn=9, va[vn];
for (int i = 0; i < vn; i++) va[i] = i * (vn – 1 –i);
for (int i = 0; i < vn; i++) cout << va[i] << “,”;
cout << endl;
}
```

1) Calculates values of array va[]
2) Prints the values of first vn elements of va
3) Initializes the array va and prints it
4) Finds maximum element in the array

Peer instruction - Identify the courses or topics apt for this activity

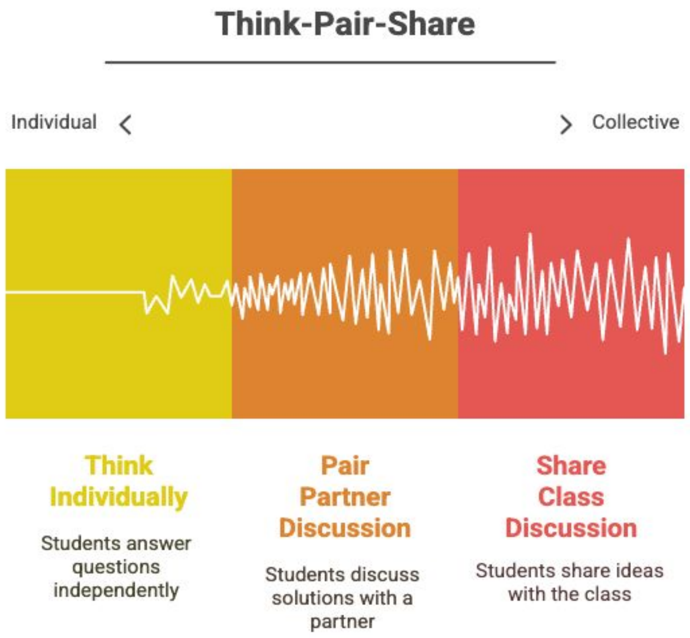
Active learning strategies for f2f setting

- Peer Instruction
- Think-Pair-Share
- Flipped Classroom (Using MOOCs or other online resources)
- Constructivism & Project-Based Learning (PBL)
- Experiential learning
- Inquiry-Based Learning
- Socratic Questioning & Debate Techniques
- Pair Programming
- Jigsaw Method
- Game-based learning

Think-Pair-Share (TPS) Technique

Download the TPS-activity-constructor resource sheet from -

https://www.et.iitb.ac.in/products/teaching-resources



TPS Implementation

- **T (Think): (~ 3 mins)**
  - Teacher poses a specific question about the topic.
  - Students "think" and write their own individual answer.
  - Example: How will you sort a given set of numbers?

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- **S (Share): (~8-10 mins)**
  - Students share their thinking (or solution) with the class.
  - Teacher facilitates a discussion on the topic.
  - Example: Discussion on different types of sorting algorithms.

TPS in CS101: Example 1

"Consider an unsorted array of N elements".

- **Think:** Write the pseudocode for sorting the array.
  - Students do: Write down answer the given question.
  - Instructor does: Encourages students to write, instead of working mentally.

TPS in CS101: Example 1

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- **Pair:** Discuss your answer with your neighbor, do pros and cons analysis of your algorithms.
  - Students do: (i) Identify parts of the answer that they have missed out. (ii) Discuss which answer is better; do pros-cons analysis if there are multiple solutions.
  - Instructor does: (i) Walks around the class to get a feel of student solutions. (ii) Gives comments where necessary, to ensure that discussion is on-track.

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- **Share:** Participate in discussion of your solution and others.
  - Students do: (i) Share their own solution. (ii) Critique other's solutions.
  - Instructor does: Discusses (i) What are all the essential parts in the answer? (ii) Pros-cons of various solutions given by students.

This TPS activity led to a discussion of various sorting algorithms.

TPS in CS101: Example 2

Suppose you have to write a Taxi Service program. When a driver arrives, his ID is entered in an array driverID (if the array has space). When a customer arrives the earliest waiting driver (if any) in driverID is assigned to the customer.

- **Think:** What struct and variables are required?
- **Pair:** Discuss the pseudo-code for the functions that are required.
- **Share:** Compare with demo18-queue.cpp (demonstration of queue implementation in C++)

TPS set up guidelines

- Ensure that there is a clear 'deliverable' for each phase. This drives the action in that phase.
- Ensure that the phases are logically connected. They should use the output of one phase in next.
- Ensure that there is sufficient time for each phase.
    - Too little ⇒ Frustration
    - Too much ⇒ Boredom
    - Move on when 80% of the class has finished.

Reflection spot - TPS for your topic

Write a question that you could use for TPS in your next class

Post your response via this link - https://www.menti.com/al31dmun5igz

Or go to menti.com and type this code 8594 3238

[Responses]()

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.

Debate (~5 mins)

Group A

Why Teacher A's strategy is "better" than Teacher B?

- Basic understanding of topic and similar problems for hw.
- Don't watch videos -
- Cannot control what student do outside of class
- incentivize students
- Orchestration challenges in class
- Managing 60-70 students in class
- Motivate them to learn - real life

Group B

Why Teacher B's strategy is "better" than Teacher A?

- Creating curiosity about topic sharing video
- Discuss with peers
- Problem solving - curbing AI tool
- Level of understanding - they've watched the video - asking questions
- N number - repeat video - self-paced
- Real life examples
- More time to solve problems - many questions will come
- Peer learning suitable

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
  - Can watch lecture video at own pace.
  - Can get immediate help from peers and teacher during problem-solving.

- Key drawback:
  - Teacher effort to create the video.

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

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- **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.

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.

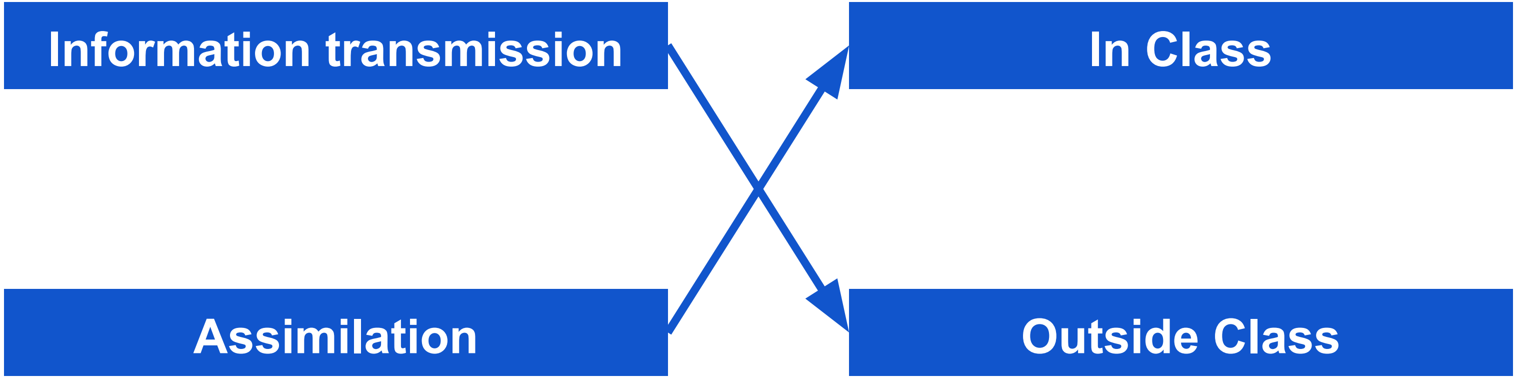
- **Students** study individually or in groups
  - typically happens just before assignment submission deadline or exam.
  - may focus on assessment, not on concept attainment.

Flipping the classroom - **From**

Information transmission → **In Class**

Assimilation → **Outside Class**

Flipping the classroom - **To**



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, MIT OpenCourseWare, NPTEL, Spoken Tutorials

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.

Why Flipped classroom works?

- 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.

TPS Activity

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.

TPS Activity - **Think (Individually)**

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 you 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).

TPS Activity - **Pair (with peer)**

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.

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). (~5 minutes).

TPS Activity - **Pair (with peer)**

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.

Share:

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

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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 <u>exposure to the topic</u> before class.

2. Provide <u>incentives</u> for students to prepare for class.

3. Facilitate <u>higher level cognitive</u> activities in the classroom.

4. Provide mechanisms for students to get <u>feedback</u> from peers and instructor.

Some effective in-class activities during flipped classroom

- **Peer Instruction questions** - for ensuring 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.

Constructivism and Project-based learning

Constructivism: philosophy based assumption that knowledge cannot exist outside our minds. Knowledge cannot be given from one mind to another.

New knowledge is ‘constructed’ or created from within individuals through experience.

Famous thinkers

🧠 Jean Piaget - Emphasized how learners build mental models through interaction.
🧠 Lev Vygotsky – Highlighted the role of social interaction and cultural context in learning (e.g., “Zone of Proximal Development”)

Constructivism and Project-based learning

Project-based learning (PBL) is a pedagogical approach that is rooted in the theory of **constructivism.**

What is PBL?

PBL is a teaching method in which students learn by actively engaging in real-world and personally meaningful projects.

How have you implemented PBL in your classroom?

How does PBL differ from “doing a project”?

Aspect	PBL	Doing a project
Timing 🕰️	The project is the learning process	The project comes after the content is taught
Purpose 💭	To learn through inquiry and creation	To show what was learned (often a summary or display)
Driving Question ❓	Starts with a real-world problem or open-ended question	Often based on a teacher-assigned topic
Process 🔂	Involves sustained inquiry, iteration, feedback, and reflection	Often a one-off task with limited depth
Collaboration 👬👭	Emphasizes teamwork and role-based problem solving	May be done individually or as divided group work
Assessment ✍️	Based on process, product, and reflection	Usually focused on final product only

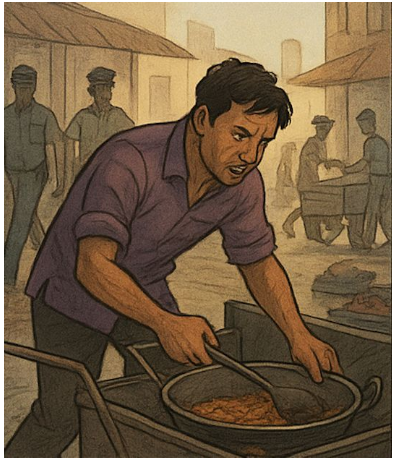
Personal experience of PBL

User Studies Course

Conducting interviews as part of course

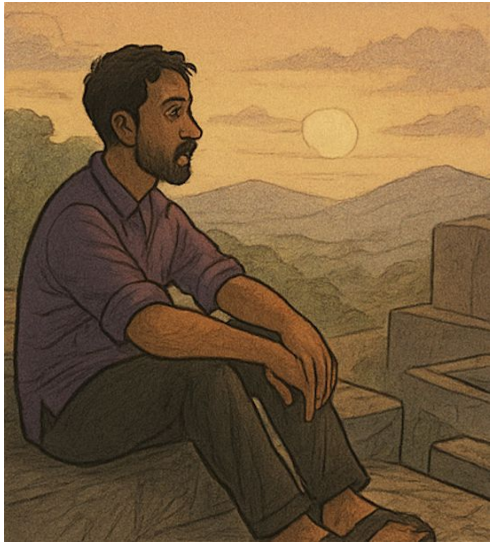
Assimilation post interviews

Building an Affinity Map from Field Interviews



Ajit (30) runs a makeshift pav bhaji stall, hastily dismantles it to avoid BMC officials, and sprains his ankle—an old injury from a fall when he worked as an electrician.



A customer asks Ajit, "Where were you in the afternoon?" to which he replies by recounting his ordeal with the BMC officials. Ajit runs the stall with his brother and occasionally travels to his hometown, Pune.

Personal experience of PBL

User Studies Course

Conducting interviews as part of course

Assimilation post interviews

Building an Affinity Map from Field Interviews

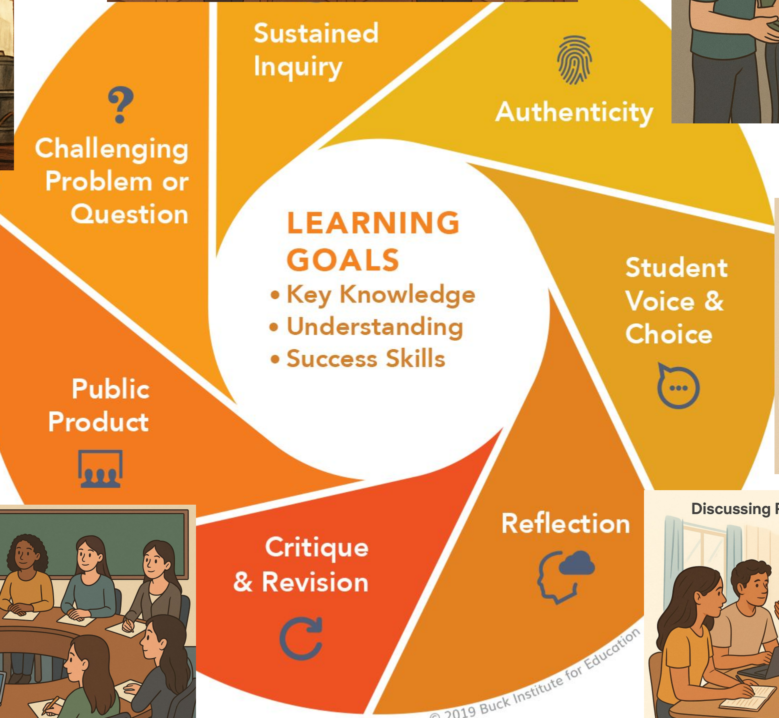
Creating a prototype

Conducting interviews and demonstrating prototype

Personal experience of PBL

Writing reflections in hotel

Gold Standard PBL (s)



PBL or Not?

Scenario 1: Final-year CS students are asked to develop a digital solution for small local shops to manage inventory. Students start with field visits, interview shop owners, identify user needs, brainstorm solutions, iterate on prototypes, and present final designs to the community and shopkeepers. Faculty provide ongoing guidance but do not assign step-by-step tasks.

VOTE: Is this PBL?

1) Yes
2) No
3) May be

PBL or Not?

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VOTE: Is this PBL?

1) **Yes**
2) No
3) May be

Looks like a strong fit — why?

PBL or Not?

Scenario 2: Students are assigned to build a library management system using a fixed set of technical requirements. The project is done individually over 2 weeks. Code is assessed on correctness, UI polish, and documentation. No actual users are consulted or involved in the process.

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1) Yes
2) No
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PBL or Not?

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VOTE: Is this PBL?

1) Yes
2) **No**
3) May be

Feels like a traditional assignment — but is there any learning value beyond content delivery?

PBL or Not?

Scenario 3: Students engage in a 3-day university-sponsored hackathon. They choose from predefined problem statements (e.g., smart city apps), form self-selected teams, work with tech mentors, and create working prototypes. At the end, teams pitch their ideas to a panel of judges and win prizes.

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1) Yes
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Engaging and collaborative — but does short-term intensity replace sustained inquiry?

PBL Teacher Checklist for Effective Implementation

- ❑ **Design and Plan:** Choose a real-world problem. Plan stages, but leave space for student voice & choice.

- ❑ **Align to Standards:** Link project tasks to key CS concepts and learning outcomes. Stay focused on depth.

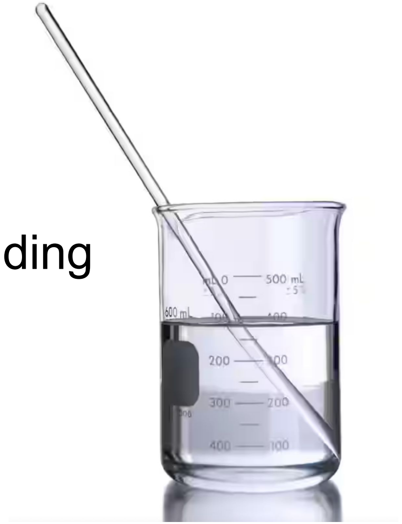
- ❑ **Build the Culture:** Foster trust, teamwork, and a safe space for questioning, feedback, and iteration.

PBL Teacher Checklist for Effective Implementation

- ❑ **Manage Activities:** Break work into milestones. Set timelines, checkpoints, and define clear roles.
- ❑ **Scaffold Learning:** Provide mini-lessons, tools, and templates. Offer “just-in-time” support.
- ❑ **Assess Learning:** Use formative and summative assessment. Include peer/self-review of both process & product.
- ❑ **Engage & Coach:** Be a learning partner. Observe, ask questions, guide reflection, and cheer progress.

Inquiry-Based Learning

Inquiry-based learning (IBL) is a pedagogical approach that is rooted in the theory of **constructivism.**

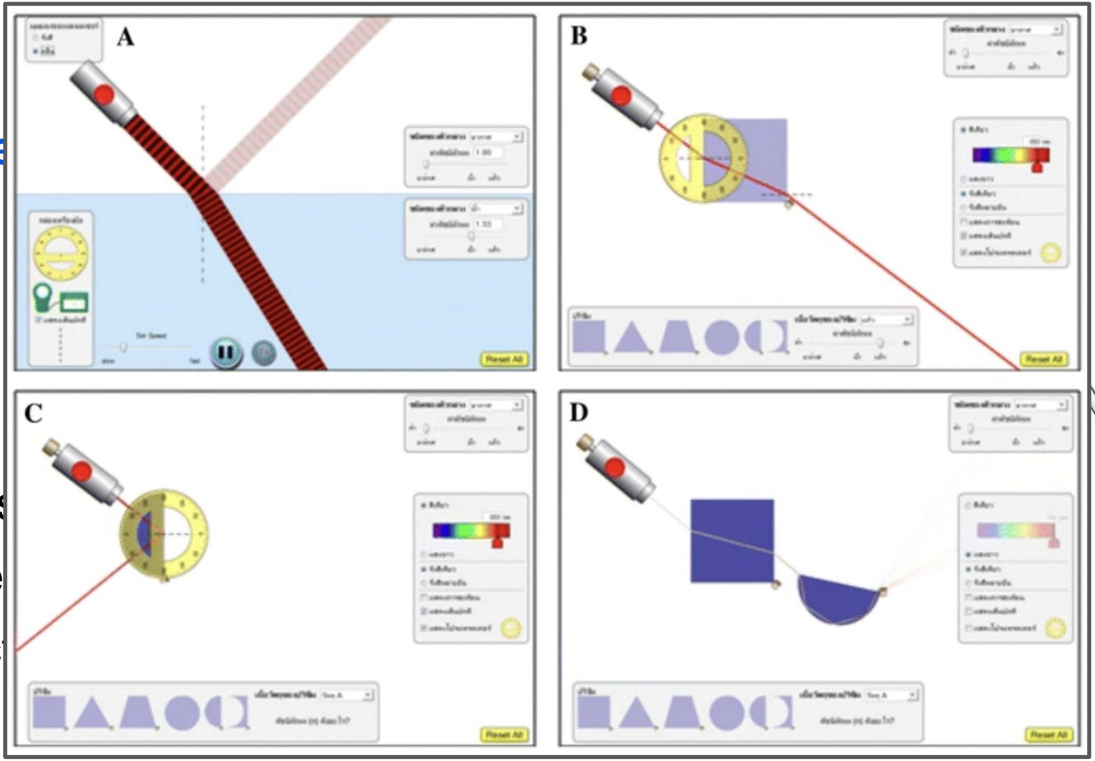


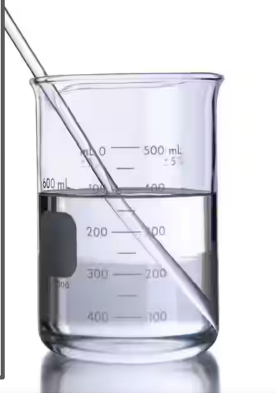
What is IBL?

- Students ask questions, investigate, and build understanding
- Emphasizes curiosity, reasoning, and reflection
- Teacher acts as a guide, not an answer-giver

Inquiry-Based Learning

Inquiry-base rooted in the





What is IBL?

- Students as
- Emphasize
- Teacher ac

IBL vs PBL

Goal

- IBL: To investigate and understand a question or concept
- PBL: To solve a problem and create a product or solution

Outcome

- IBL: Deep conceptual understanding
- PBL: A tangible, publicly shareable product

Product

- IBL: Optional or secondary
- PBL: Essential and expected

Socratic Questioning

What is Socratic Questioning?

- A method of **disciplined questioning** used to **explore complex ideas**.
- Named after **Socrates,** who used questioning to **promote critical thinking** and **uncover assumptions.**
- Helps students **think deeply**, justify their **reasoning**, and **reflect**.

Why Use Socratic Questioning?

- Encourages **active learning**
- Develops **critical thinking**
- Promotes **reflection and reasoning**
- Builds **dialogue** instead of passive reception

Socratic Questioning

Category	Sample Question
1. Clarification	“What do you mean by…?”
2. Challenging Assumptions	“What could we assume instead?”
3. Evidence and Reasoning	“What is the evidence for that?”
4. Alternative Viewpoints	“What is another way to look at this?”
5. Implications/Consequences	“What are the consequences of that decision?”
6. Meta-Questions	“Why is this question important?”

Socratic Questioning

Tips for Effective Use

- Be patient with silence
- Encourage students to build on others' ideas
- Don't answer your own questions
- Use wait time
- Guide, don't lecture

Sample Classroom Exchange

Teacher: What is recursion?
Student: When a function calls itself.

Teacher: Why would a function do that? Can you give a real-world analogy?

Student: Maybe like Russian nesting dolls?

Teacher: Interesting. What would be the "base case" in that analogy?

Socratic Questioning - Pair Activity

Topic: ____________________

Type of Question	Your Question
🔍 Clarifying Question	
🧠 Reasoning-Based Question	
🔗 Consequence-Focused Question	

Socratic Questioning - Example

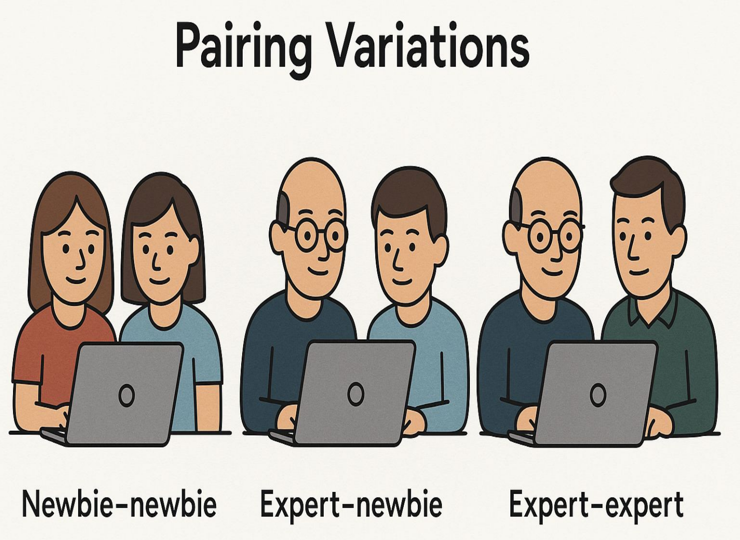
Topic: <u>Loops</u>

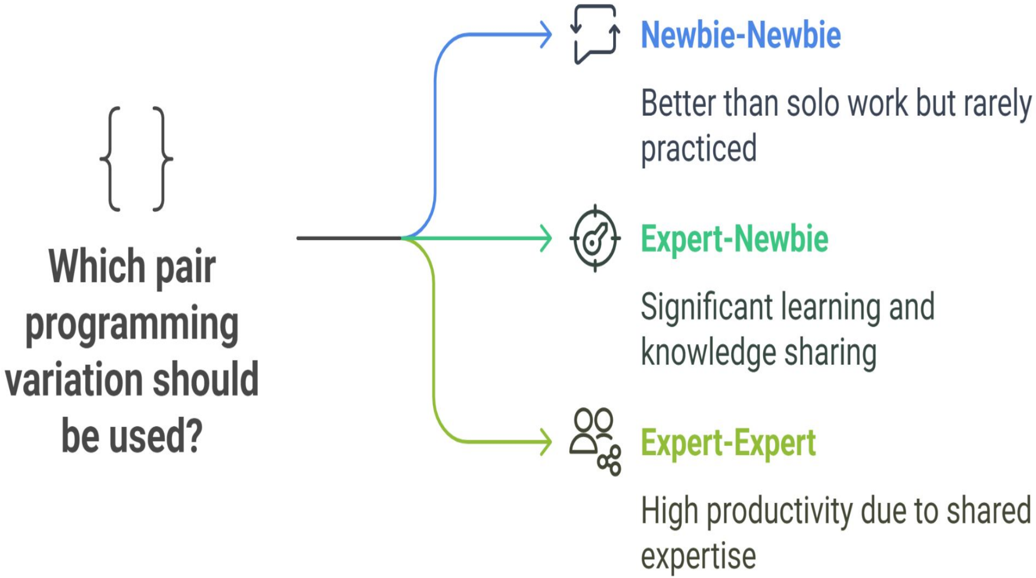
Type of Question	**Your Question**
🔍 Clarifying Question	**What does a loop do in a program?**
🧠 Reasoning-Based Question	**Why might we choose a ‘for’ loop over a ‘while’ loop?**
🔗 Consequence-Focused Question	**What are the consequences of a loop that never ends?”**

Pair Programming

Pair programming is a collaborative programming practice where two developers work together at one workstation. One is the ***Driver*** (who writes the code), and the other is the ***Navigator*** (who reviews and guides). They switch roles frequently.

Pair Programming





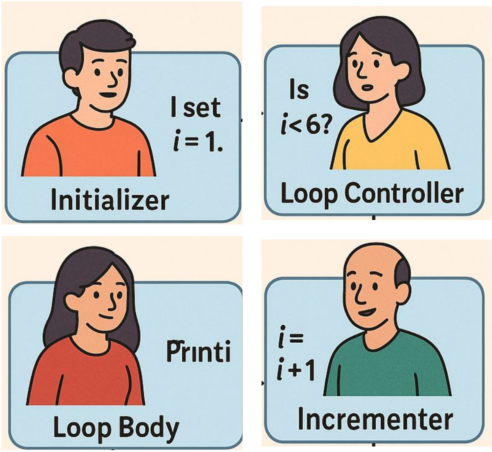
Pair Programming - Identify the courses or topics apt for this activity

Game based learning- Role Play

Depicting the Role Play: For Loop as a Team

Roles:

- **Initializer**: "I set i = 1."
- **Loop Controller**: "Is i < 6?" - "Yes/No."
- **Loop Body**: "Print i."
- **Incrementer**: "i = i + 1."



Flow:

1. Initializer sets i = 1 → tells Loop Controller.
2. Loop Controller checks the condition: "Is i < 6?" - Say “Yes/No”
3. If yes, Loop Controller tells Loop Body to execute.
4. Loop Body prints i.
5. Incrementer adds 1 to i → tells Loop Controller.
6. Repeat until Loop Controller says "No."

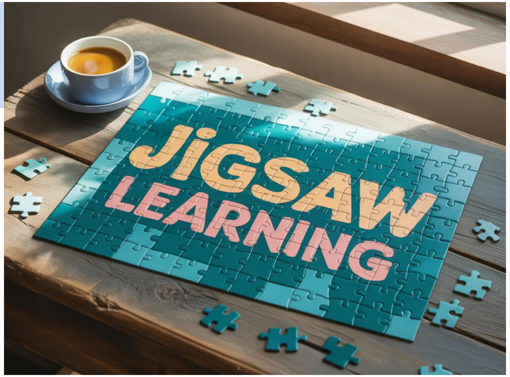
Gamification

Applying Game elements in non gaming contexts such as in education is gamification.

- Kahoot
- Triviamaker
- Mentimeter
- Quizlet
- Bamboozle
- Quizizz

More on CS specific games and gamification ones tomorrow!

Cooperative learning- Jigsaw

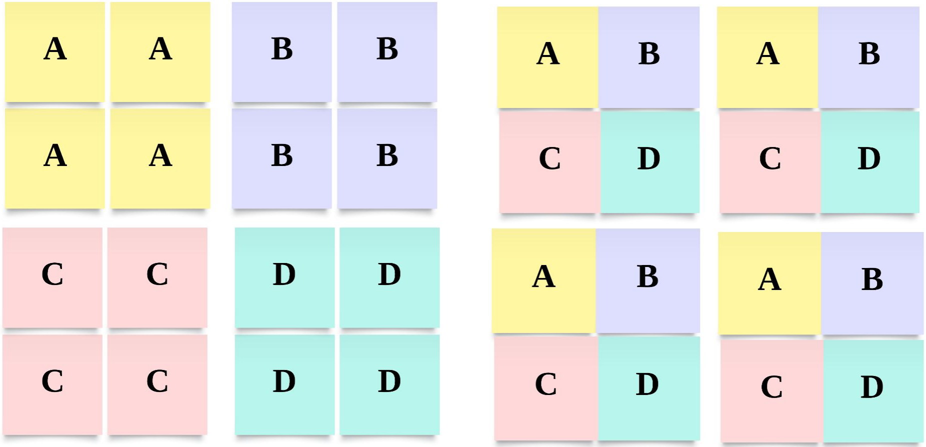


Objectives:

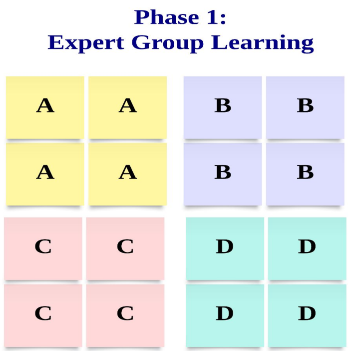
- Help student build comprehension.
- Encourage cooperative learning among students.
- Improve listening, communication, and problem-solving skills.

Phase 1:
Expert Group Learning

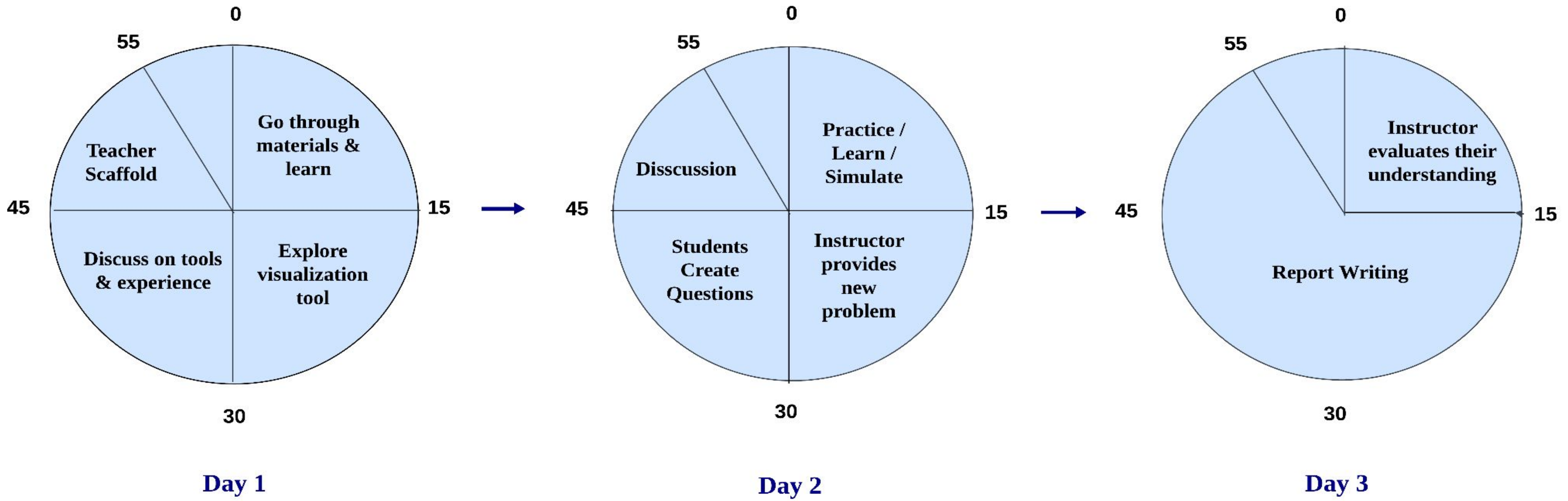
Phase 2:
Home Group Learning



Cooperative learning- Jigsaw

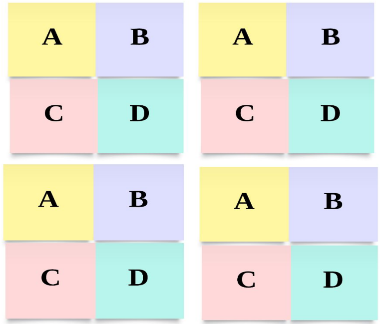


Expert Group learning - Students with the same segment from different groups meet to discuss and enhance their understanding.

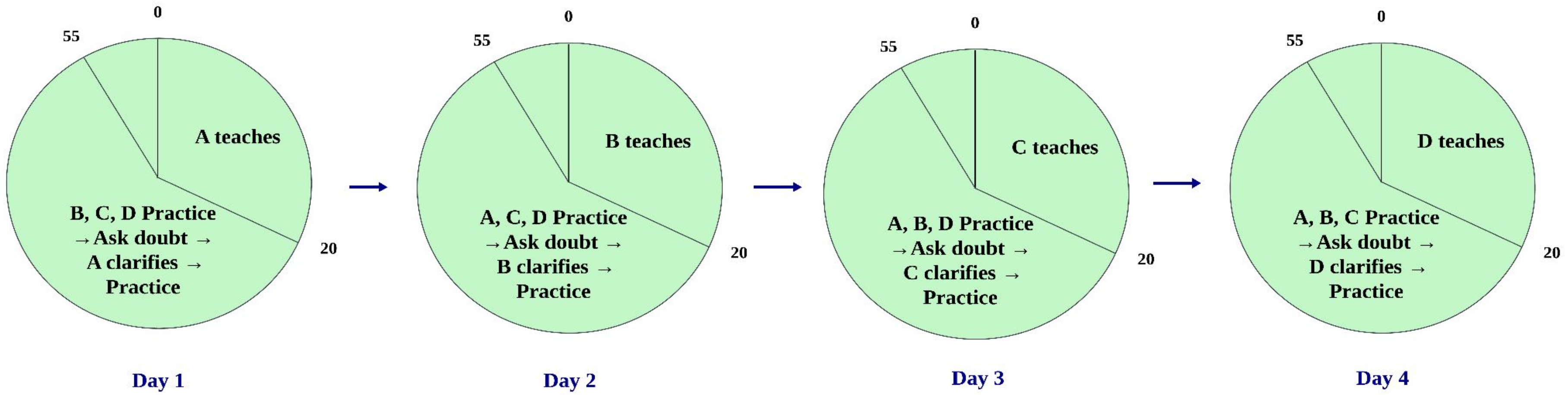


Cooperative learning- Jigsaw

Phase 2:
Home Group Learning

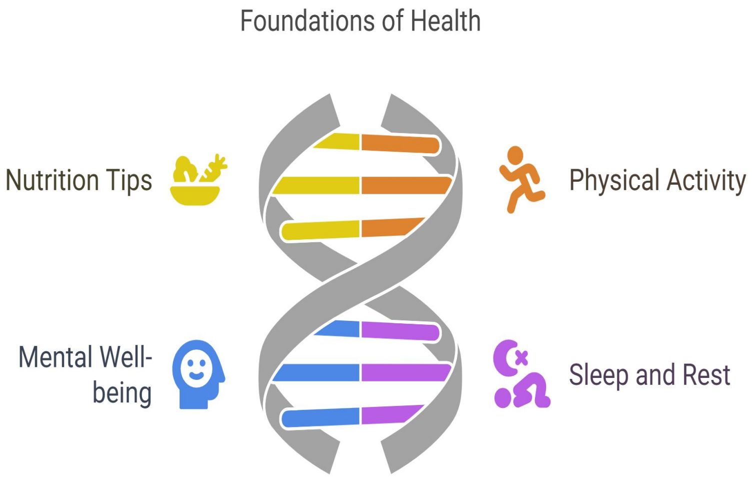


Home Group learning: Students return to their original groups to teach the segment, ensuring that all group members learn the entire topic. This process ensures that every student is both a teacher and a learner.



Jigsaw Activity: “**Foundations of Health**”

Objectives: Experience the Jigsaw Method through a simple topic



4 Subtopics (Each person becomes an “expert” in one)

A. **Nutrition Tips**

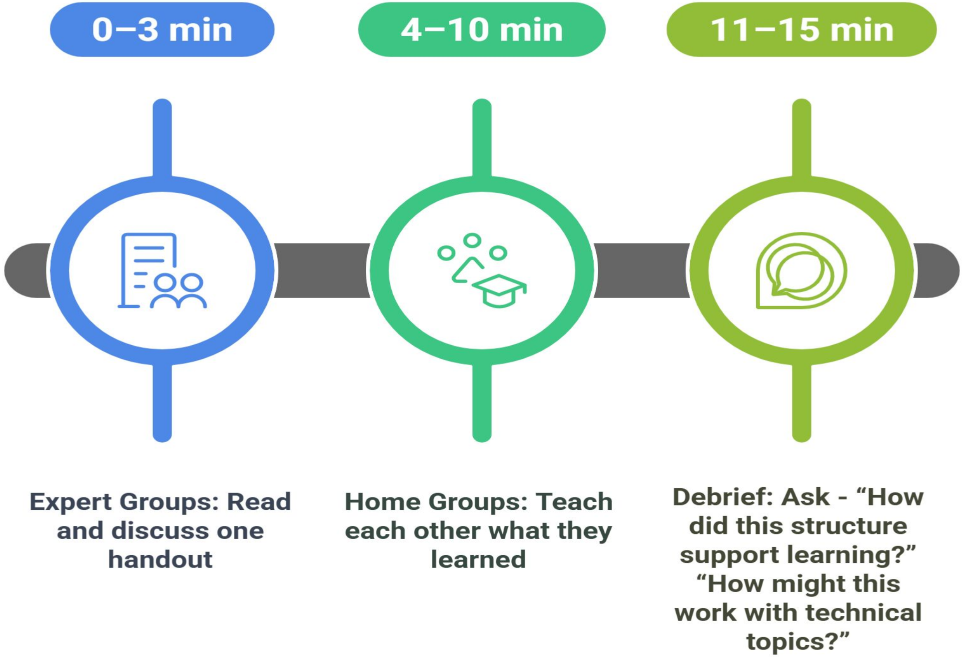
B. **Physical Activity / Exercise**

C. **Mental Well-being / Stress Management**

D. **Sleep and Rest**

Jigsaw Activity: “**Foundations of Health**”

[Expert group handout]



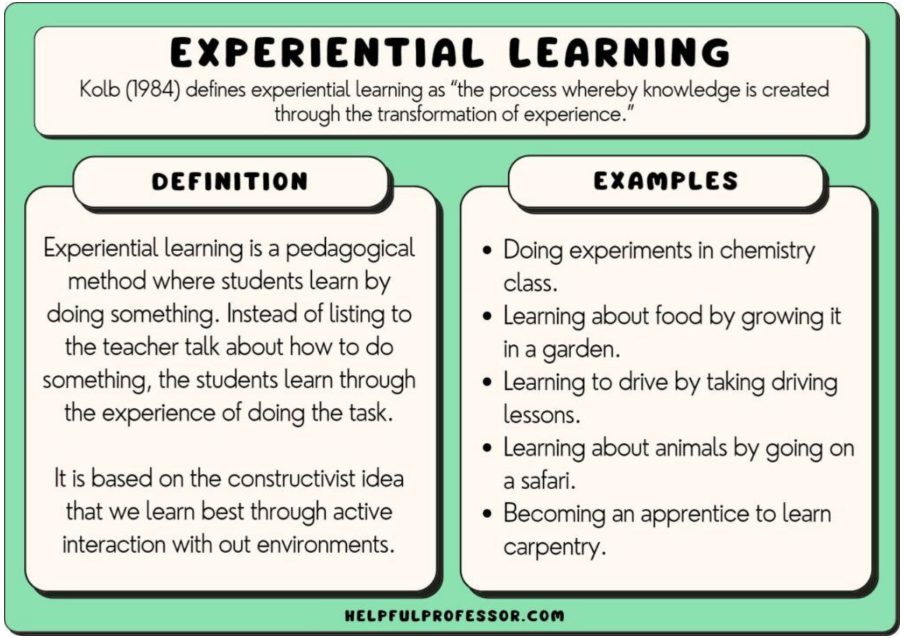
Jigsaw Activity - Identify the courses or topics apt for this activity

Experiential learning

What is Experiential Learning?

> ***"Learning is the process whereby knowledge is created through the transformation of experience."*** — David Kolb

- Learning by doing
- Reflection is integral
- Encourages deep and active learning



Experiential learning- Hackathon in Machine Learning course

To explore experiential learning as it is an engaged learning process whereby students **“learn by doing”** and **by reflecting on the experience.**

Our goal was to accutom students with a live machine learning project.

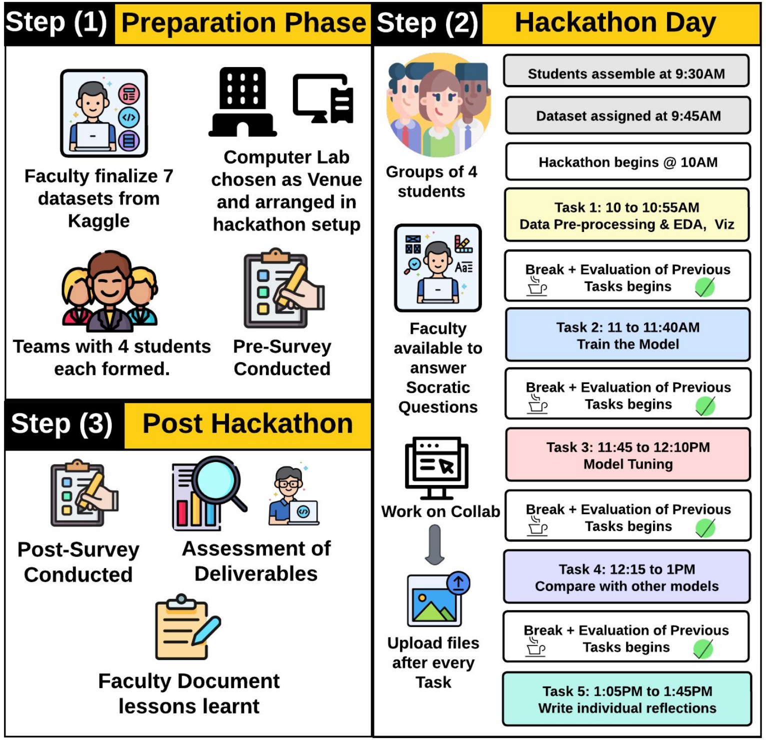
Objective-

- Students gain **real time experience** in solving problems using machine learning algorithms
- Students explore kaggle datasets for **applying their conceptual knowledge** .
- Experiential learning can **foster** students’ **problem solving skills**

The instructor and student may experience success, failure, adventure, risk-taking and uncertainty, because the outcomes of the experience cannot totally be predicted.

Challenges- Faculty had to define the process as this is done for the first time in the department. Since the students are in their sixth semester we had to select less complex datasets.

Experiential learning- Hackathon in Machine Learning course



Experiential learning- Software Engineering course

Revamped a software engineering course to mimic a software company with projects, daily scrum, weekly deliverables, retrospective, planning, reviews meetings and monthly progress demos.

Sprint	Topic	Deliverables
0	Introduction to SE, Process Models	Team Proposal and Project Selection
1	SDLC and Project Planning	Sprint 1 work products such as Project Schedule Draft, Github repo link, and Scrum board
2	Software Requirements	Sprint 2 work products including SRS gathered from user research
3	Software Design	Sprint 3 work products such as Analysis Model Diagrams, Design patterns, Architecture models
4	Software Maintenance and Evolution	Implementation of Features and Team Project presentations (updates)
5	Software Practices and Professional Ethics	Implementation of Features and Team Project presentations (updates)
6	Software Testing	Testing plan
7	Cross-Functional Teams and Roles	Cross Team Testing results
8	Software Accessibility	Accessibility Testing results
9	Working Week - Fixing bugs (both functional and non-functional including a11y)	NIL
10	Final Week Team Presentations	Team Reflection Talk and Update documentation

Experiential learning- Participants ideas

Thank You ✿

Open for questions / Chat over Lunch

Daily Post Lunch Activity & Deliverables

- Work on implementing active learning in a course/topic in groups.
  - Groups as per Course tracks.
- Scaffolded support document available at
  - https://tinyurl.com/FDevPDay1
- Groups can remain same for all the days.
- 4th July → Everyone present their plan of their revamped courses.
  - Including current approach, revamped approaches, rationale, how success will be measured etc. for 10 minutes each.

Daily Post Lunch Activity & Deliverables