Active Learning

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How to use this document?

Effective pedagogies depend upon the alignment between learning objectives, assessments and instructional strategies. This document gives an overview of what is active learning and various strategies to implement active learning with or without use of technology. It also includes description about why to use active learning strategies along with research evidences.

More details can be found in reference list provided at the end.
Who should use it?

It will be useful to use these strategies, if you are designing activities focusing on higher-order thinking skills (HOTS) or designing pedagogical strategies for Technology Enhanced Learning (TEL) environments.

Especially if you are:

- Teacher or Trainer who has to design/implement active learning pedagogy for classroom activity OR
- Researcher who has to study psychology of learning with active learning strategies OR
- Instructional Designer who has to develop multimedia content using active learning pedagogies.
What is active learning?

“Approach to teaching and learning whose goal is to engage students with the content via specific activities that get students to talk, write, reflect and express their thinking.” *

Active learning is sometimes collectively referred to the strategies that make students do something other than just listening to a lecture or watching lecture video. These activities might be discussions, drawing concept maps, argumenting and asking questions etc.

*http://www.et.iitb.ac.in/Resources/files/TPS/ppt014tps-idpET-Dec2013.pptx
Features of Active Learning Strategies*

While doing active learning, students are:

- required to elicit ideas and address e.g. devise possible reasons for an observation (shown in a video).
- asked to “figure things out for themselves.” e.g. figure out the next step in the derivation.
- asked to express their reasoning explicitly.
- required to work collaboratively e.g. brainstorm a list of methods to solve a design problem.
- engaged in problem-solving activities during class time.
- receiving rapid feedback on their work.
- required to do qualitative reasoning and emphasize on conceptual thinking eg: debate pros & cons of various methods.

*http://www.et.iitb.ac.in/Resources/files/TPS/ppt014tps-idpET-Dec2013.pptx
Why active learning?-Research based evidences

- **Meta-analysis of 225 studies (2014)**
  Exam performance: higher by 0.47 standard deviations in active learning courses—~1/2 letter grade increase
  Failure rates: 33.8% in traditional classes vs 21.8% in active learning courses

- **Comparative study of 62 Physics courses (1998)**
  6542 students from a variety of institutions: high school, college, university responded to test of conceptual reasoning –Force Concept Inventory, Pre-post, semester long
  AL courses had gains 2-3 times greater than lectures.
  Gain from active-learning courses had a wide range: 0.23-0.7


What might make active learning not work?

- If the activities are too trivial and do not require the students to do activities like write, draw, compare, evaluate then students might not get the value in the activity.
- Giving too little time or too much time: Too little time might not allow them to think on the details which you want them to think on. Giving too much time might lead to digression.
- Giving too complex problems: The nature of discussions around the problem might be too varied and it might get hard to moderate.
Active learning strategies examples

● Without Technology:
  ○ Think Pair Share (TPS) [Frank Lyman, University of Maryland, early 1980s]
  ○ Peer Instructions (PI) [Eric Mazur, Harvard University, early 1990s]
  ○ Predict-observe-explain (POE)
  ○ Role playing
  ○ Problem-based learning
  ○ Productive failure

● With Technology (Teacher-led classroom):
  ○ Problem solving using real data
  ○ Project based learning using wikispaces
  ○ Online discussion and commenting

● With Technology (Self-learning TEL environment):
  ○ Discovery learning using simulation
  ○ Creating Concept map using CMAP tool
Predict - Observe - Explain (POE)

This strategy consists of 3 phases: Predict, observe & explain. This is used to understand prior knowledge of students, generate discussions, to engage them. This works well when there is an element of surprise.

- Classroom implementation:
  Predict: Student are explained/showed a video about an experimental setting. Then they have to predict the outcome of the experiment along with the rationale behind the prediction. It is important that they note it down.
  Ex: Students are shown a picture and asked to explain what happens when the round bottom flask is immersed in hot water.
  This step elicits the prior understanding of the students about the concept being taught. This also prepares them for the next step, ‘Observe’ by making them aware of gaps in their knowledge or making aware of important observation to make.

**Predict - Observe - Explain**

**Observe:** Students are allowed to perform the experiment by themselves or watch a video of complete experiment. Ex: A video clip showing what happens when the round bottom flask is immersed in hot water. This phase might create a surprise in students if they observe that experimental outcome is different from what they had predicted. This is an important element in generating motivation or resolving misconception.

**Explain:** Students are asked to share an explanation of the experiment accounting for the initial prediction and the following observation.
**Predict - Observe - Explain**

**Implementation in a TEL:**

**Predict:** Show a video of the experiment, scenario only till the point to make student students understand required background knowledge. Ask the students to write their prediction along with the rationale behind it (in their notebook or in the TEL environment).

**Observe:** Continue the video till the students can make required observations.
Predict - Observe - Explain

Implementation in a TEL:

Explain:
If collaboration is possible between students, then let the students share their explanation in front of their peers. Let the students discuss and inform them the correct explanation and rationale at the end of discussion.

If collaboration is not possible then any one option from below can be used:
1) Display the correct explanation and rationale and ask the student to compare it with their explanation
2) Get the correct explanation & rationale from students using MCQs. Provide appropriate feedbacks for the options chosen.
Predict - Observe - Explain

Implementation in a TEL:

**Predict:**
Within [Mic-O-Map](#) learner interact with simulation and predict current Vs voltage graph of PN junction.
Predict - Observe - Explain

Implementation in a TEL:

Observe:
Within Mic-O-Map learner interact with simulation and give reason behind selected current Vs voltage graph of PN junction.
Predict - Observe - Explain

Implementation in a TEL:

Explain:
Within Mic-O-Map learner interact with simulation and explain current Vs voltage graph of PN junction.
Think Pair Share (TPS): Definition

T (Think): Teacher asks a specific question about the topic. Students "think" about what they know or have learned, and come up with their own individual answer to the question. [Takes 1-3 Minutes].

P (Pair): Teacher asks another question, related to the previous one, that is suitable to deepen the students’ understanding of the topic. Each student is paired with another student. They share their thinking with each other and proceed with the task. [Takes 5-10 Minutes].

S (Share): Students share their thinking (or solution) with the entire class. Teacher moderates the discussion and highlights important points. [Takes 10-20 minutes].
Think Pair Share (TPS)

Points to note:

- 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.
Think Pair Share (TPS) - Example

● Classroom implementation:
  ○ Domain: Computer Programming
  ○ Think: Ask the students to write a program.
  ○ Pair: Ask them to analyze the efficiency of the program.
  ○ Share: Let the students share their version of the most efficient program.

● Implementation in a TEL:
  ○ Think: Ask the students to write program in a shared space like a wiki.
  ○ Pair: Students discuss the efficiency of the program in pairs by commenting on each other’s program.
  ○ Share: Students can create a new efficient program after the discussion and share it with the class.
Project based learning using wikispaces

● Project based learning includes activities like:
  ○ problem decomposition
  ○ coming-up with diverse solutions (convergent and divergent thinking)
  ○ data collection
  ○ discussion and conclusion

● Following are the advantages of using wikispaces in project based learning.
  ○ monitoring facility: Individual tracking of contributions can be made
  ○ comparison between versions can be made
  ○ repository of files can be created
  ○ projects can be grouped year wise (May be used as a course repository)
  ○ details of: project structure, Rubrics, choosing members
  ○ work division
Case Studies

“Case studies are stories which present realistic, complex, and contextually rich situations”*. Description of cases can vary from few paragraphs to lengthy writeup~ 20 pages. A case based discussion involves following steps:

- Brief introduction about the case and how you want students to think about the case eg “Approach this case as if you were the presiding judge.”
- Ample time to study cases.
- Individual participation.
- Group presentation of their solutions/ reasonings.
- Guiding questions for the discussion.
- Synthesis of issue in the end.

Additional resources for case study teaching in science can be found in the following link: http://sciencecases.lib.buffalo.edu/cs/

*https://www.cmu.edu/teaching/design/teach/instructionalstrategies/casestudies.html
Role Playing

In role playing strategy, students look at the topic from a particular perspective who affects and are being affected by that role. This strategy helps student to engage in higher order thinking and deeper analysis of content. It also helps them to apply content in real world context.

Following steps are followed to design role playing activities:

- Choose relevant scenario.
- Stipulated time to complete the task.
- Stating expected deliverables which may be in the form of reports or presentation.

Further detailed information on designing role playing activities can be found on http://serc.carleton.edu/introgeo/roleplaying/howto.html
Puzzles

You can include short puzzles/quizzes in between your TEL modules. Some examples are given here:

- Crosswords
- Jumbled words
- Short questions in between a video

Make sure that the puzzles are related to the content that they are learning. Refer h5p.org for more ideas or details on implementing these in a web-based environment.
References


2. https://www.cmu.edu/teaching/technology/index.html