Active Learning Practice (ALP)
Assignment

**Purpose:** This session offers a safe environment for new engineering student-instructors to:
1. practice engaging students in active learning,
2. observe peers using active learning strategies, and
3. exchange constructive feedback for improving the implementation of such strategies.

**Registration:** Choose one of several sessions at [http://crlte.engin.umich.edu/aptregistration/](http://crlte.engin.umich.edu/aptregistration/)

**Assignment:** Prepare and lead a **10-minute interactive session** using **one of the 6 active learning strategies** listed below. You may choose the topic and context of your lesson, depending on your role. Your audience will be a small group of engineering GSIs/IAs and one trained facilitator (about 4 other people), who will both act as students during your session, and provide feedback after the session. Focus on engaging “the students” to maximize learning. Note that your “students” may have different levels of background knowledge about your topic, and plan accordingly.

**Planning:**

1. **Select a topic:** What do you want to your students to learn? What can students reasonably learn in ten minutes?

2. **Develop a clear and well-organized lesson.** You may use the template attached, which is summarized and adapted for this session in the steps below. While it is generally good teaching practice to strive to incorporate all of these steps in a lesson, it may not be feasible to do so within your ten-minute lesson.
   a. Determine **1-2 learning objectives:** What should students know or be able to do after your lesson? What do you want students to identify, solve, analyze and/or construct?
   b. Determine how you will **check for student understanding:** How will you know if the students are learning (i.e. achieving the learning objective)? What are some specific questions you can ask during the lesson (at least one)?
   c. Develop an **introduction that helps students make connections:** What are some real-world examples or practical applications for this subject? Why is it important? Can you think of historical or personal anecdotes that would motivate student interest? How might you activate students’ prior knowledge related to this concept?
   d. Develop **learning activities:** Choose at least ONE of the following six Active Learning strategies (more information on these techniques is attached):
      - Case Studies
      - Cooperative Groups
      - Thinking-Aloud Paired Problem Solving
      - Brainstorming
      - Minute paper
      - Think-Pair-Share
   
   Decide precisely what you want them to do, and plan clear instructions for the task.
   e. Plan a short **summary** to conclude the lesson. What did you do to meet your learning objective(s)?

3. **Identify time estimates** for how long each part of the lesson will take. We suggest you limit your introduction and summary to less than 2 minutes total, and use 8 or more minutes for the active learning activity(ies).

**Resources:**
- Engineering Teaching Consultants - [http://crlte.engin.umich.edu/services/consult-service/](http://crlte.engin.umich.edu/services/consult-service/)
- Information about active learning - [http://www.crlt.umich.edu/tstrategies/tsal](http://www.crlt.umich.edu/tstrategies/tsal)
- Videos of Active learning - [http://crlte.engin.umich.edu/aptregistration/apt_podcasts/](http://crlte.engin.umich.edu/aptregistration/apt_podcasts/)
- Videos of engineering GSIs teaching - [http://crlte.engin.umich.edu/resources/gsi-videos/](http://crlte.engin.umich.edu/resources/gsi-videos/)
- Resources on Preparing to Teach - [http://crlt.umich.edu/resources/preparing-teach](http://crlt.umich.edu/resources/preparing-teach)

**Afterwards:** Reflect on your lesson, make improvements, and implement active learning in your classroom! Keep in mind that Engineering Teaching Consultants and CRLT-Engin staff will be ready to assist you with any teaching question you have during the term.
# Lesson Planning Template (LOCA-CLAS)

<table>
<thead>
<tr>
<th>LO-Learning Objectives (Direct the lesson and practice)</th>
<th>CA-Classroom Assessment (Are students getting it?)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>At the end of the lesson students will be able to ...</strong></td>
<td>Questions to check for student attainment of the LO</td>
</tr>
<tr>
<td>1.</td>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
<td>3.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C-Connections (How does the lesson connect to prior knowledge, to the big picture, to student interests and values?)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LA-Learning Activities (What are you teaching? How will the students engage with the content as you teach?)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>S-Summary (Recap the objectives in different words, preview what’s to come)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
What is active learning?

Active learning is a process whereby students engage in activities, such as reading, writing, discussion, or problem solving that promote analysis, synthesis, and evaluation of class content. We learn best by doing.

“Active Learning is, in short, anything that students do in a classroom other than merely passively listening to an instructor's lecture. This includes everything from... short writing exercises in which students react to lecture material, to complex group exercises in which students apply course material to 'real life' situations and/or to new problems.” (Paulson & Faust, n.d.)

Why use active learning?

Research studies have shown that active learning practices (like the six options on back) boost student engagement with course material, enhancing learning and increasing performance on assessments. Integrating active learning practices into the classroom also helps to personalize learning and build a learning community among students and instructors.

“As we have seen, a major problem with the lecture is that students assume a passive, non-thinking, information-receiving role. Yet, if they are to remember and use the information, they need to be actively engaged in thinking about the content presented.” (McKeachie, 2005)

How can you incorporate active learning into engineering classroom?

There are many ways to use active learning in the classroom. The table on back summarizes some simple approaches described by others (Active learning, n.d.; Felder & Brent, 1994; Felder & Brent, Fall 2003; Felder & Brent, Summer 1994; Paulson & Faust, n.d.). More examples of active learning teaching methods can be found in the GSI guidebook (pp. 86-87), or at http://www.crlt.umich.edu/tstrategies/tsal

Does active learning work?

Some examples of research findings on the impact of active learning include:

- Freeman et al. (2014) conducted a meta-analysis involving high enrollment lectures and found that active learning increased student performance on exams by an average of 6%, and decreased failure rates for these courses from 34% to 22%.
- Reimer et al. (2016) found active learning to be particularly beneficial to first-generation college students in STEM courses, boosting both retention and passing rates.
- Gray et al. (2010) found students who used 'hands-on' active learning outperformed the control group, who passively received a lecture, on a concept test by a mean of 68%.

“In short, if you start using active learning in your classes, you can expect to see some initial hesitation among the students followed by a rapidly increasing comfort level, much higher levels of energy and participation, and above all, greater learning. Check it out.” (Felder & Brent, Fall 2003)

References


<table>
<thead>
<tr>
<th>Active Learning in the Engineering Classroom - Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
</tbody>
</table>

Engineering GSI & IA Teaching Orientations

CRLT- Engin
| **Case Studies** | Use real-life stories that describe what happened to a community, family, school, industry or individual to prompt students to integrate their classroom knowledge with their knowledge of real-world situations, actions, and consequences. (See sciencecases.lib.buffalo.edu/cs/ for sample cases) | In ChemE 466 (Process Dynamics and Control) the instructor provides the students with a news-article about an explosion in a chemical plant and asks students to brainstorm reasons for the accident using the concepts learned from this course. Then asks them to act as investigators and to make a list of questions they would like to ask the plant operators to find out the actual cause of the accident. —Tabish Maqbool (Former ETC) |
| **Cooperative Groups** | Pose a question on which each cooperative group will work while you circulate around the room answering questions, asking further questions, keeping the groups on task, and so forth. After an appropriate time for group discussion, ask students to share their discussion points with the rest of the class. | Vehicle Dynamics: Provide each group with a toy car whose front and rear wheels are selectively lockable. Ask them to experimentally investigate the stability differences between rear wheel brake lockup and front wheel brake lockup. —Mark Hoffman (Former ETC) |
| **Paired Problem Solving (Thinking Aloud)** | In pairs, students describe in detail how they would solve a problem, approach a case study, or interpret data. Taking turns, one student would serve as the “explainer,” while the other student listens and asks clarifying questions. After a while, the students switch roles. | A computer programming instructor could show a code on the board and asks the one of the students in the pair to describe aloud what the code will do. The task would be repeated with another example code for the second student to describe. Afterwards the code is implemented and the results are observed. The instructor then asks why the program behaved in the expected or unexpected way. —Adapted from Fernando Tavares (Former ETC) |
| **Brainstorming** | Introduce a topic or problem and then ask for student input. Give students a minute to write down their ideas, and then record them on the board. For example, “What are possible safety (environmental, quality control) problems we might encounter with the process unit we just designed?” could be a brainstorm topic in an engineering class. | During a biomedical design course, the students are presented with a problem how to help patients with severe tremors (e.g. from Parkinson's disease) be able to do common tasks, such as eating and writing. The students break up into groups of 4-5 and write down ideas on a board, and then follow-up by further developing those ideas on a Google doc. —Matt Gibson (Former ETC) |
| **Minute Paper** | At an appropriate point in the lecture, ask the students to take out a blank sheet of paper. Then, ask the topic or question you want students to address; for example, “Today, we discussed conductive heat transfer. List as many of the principal features of this process as you can remember. You have one minute” | In AERO 550, Linear Systems, the instructor says, “Today, we discussed the controllability of linear time-invariant (LTI) systems. Without looking at your notes, list all of the equivalent ways to test for the controllability of an LTI system. You have two minutes.” —Amor Menezes (Former ETC) |
| **Think-Pair-Share** | Have students first work on a given problem individually, then compare their answers with a partner and share ideas with the class. | In IOE 310, Introduction to Optimization, the professor puts an optimization problem on the projector and asks the students to come up with the objective function and the constraints. When they have written down their answers, the students are asked to compare their solution to their neighbors. Then the instructor goes over the example for the entire class or ask students to share. —Arleigh Waring (Former EGSM) |