TEMPLE UNIVERSITY

Center for the Advancement of Teaching

Active Learning Techniques

Think-pair-share: pose a question to students that they must consider alone and then discuss with a neighbor before settling on a final answer. This is a great way to motivate students and promote higher-level thinking. A think-pair-share can take as little as three minutes (quick-response) or longer (extended response), depending on the question/task.

Application Cards: after students have learned an important principle, generalization, theory or procedure, ask them to write down at least one possible, real-world application for what they have just learned. Helps students see the relevance of what they are learning.

Classroom Polling: ask students questions throughout your lecture using a classroom response system such as TurningPoint or PollEverywhere. Using this method, the learner and instructor can both check understanding anonymously. An alternative approach to the interactive computer system is the use of colored flash cards. The teacher projects a `multiple choice' or `true or false' question and the students raise different colored cards to respond.

ConcepTest: provide a short test or quiz with multiple choice questions used to assess student understanding. These questions can be used to promote higher-level thinking such as analysis, critical thinking, and synthesis and provide a quick assessment of understanding.

Group formative quizzes: have students complete a quiz individually and then work with a group to compare and discuss answers before submitting a group answer. An added possibility is to have the group use scratch-off IF AT sheets. Allows students to assess their understanding as well as practice articulating and explaining concepts to classmates.

Empty outline: provide students with an empty or partially completed outline of an in-class presentation or homework assignment and give them limited time to fill in the blanks. Helps students to better organize and recall course content and helps faculty to find out how well students have processed the important points of a lecture or reading.

One-sentence summary: ask students to summarize information about a given topic by answering "Who does what to whom when, where, how, and why?" (WDWWWWHW) Enables instructors to find out how concisely, completely and creatively students can summarize a large amount of information on a given topic and gives students practice in condensing information into smaller, interrelated bits for easier processing and recall.

One-minute or muddiest point paper: either during class or at the end of class, ask students to produce a written response to a question. This technique can be used to collect feedback on understanding by asking them to identify what they thought the key points of a lecture are, what the most confusing point is, or to voice a question. One-minute papers allow students an opportunity to reflect immediately on what they are learning.

Concept Maps: graphical tools for organizing and representing knowledge. Allows the professor to assess the the students' beginning understanding of a concept and how it develops and grows as knowledge deepens. Helps students to visualize connections between course concepts. Students draw concept maps or use technology tools such as CMap Tools, Bubbl.us or VUE.

Case Studies: provide groups of students with a case study or complex problem. Students work through the case and present a proposed solution to the class. Note: students can be working on the same case, or each team can receive a different case.

Defining features matrix
Students categorize concepts according to the presence (+) or absence (-) of important defining features. Helps students to distinguish between closely related or similar items or concepts.

Pro and Con grid
The Pro and Con Grid gives faculty a quick overview of a class's analysis of the pros and cons, costs and benefits, or advantages and disadvantages of an issue of mutual concern. This assessment forces students to go beyond their first reactions, to search for at least two sides to the issue in question, and to weigh the value of competing claims.

Student-generated test questions: allow faculty to assess what students consider to be the most important content, what they understand as useful test questions, and how well they understand the material. They allow students to practice organizing, synthesizing and analyzing large amounts of information in order to prepare for summative assessments.

Adapted from Interactive Lecture Techniques | http://serc.carleton.edu/ and K. Patricia Cross and Thomas Angelo's book Classroom Assessment Techniques (Jossey Bass, 1993).

http://www.calstatela.edu/dept/chem/chem2/Active/main.htm

Student summary of another student's answer - In order to promote active listening, after one student has volunteered an answer to your question, ask another student to summarize the first student's response. Many students hear little of what their classmates have to say, waiting instead for the instructor to either correct or repeat the answer. Having students summarize or repeat each other's contributions to the course both fosters active participation by all students and promotes the idea that learning is a shared enterprise. Given the possibility of being asked to repeat a classmate's comment, most students will listen more attentively to each other.

Puzzles/Paradoxes - One of the most useful means of ferreting out students' intuitions on a given topic is to present them with a paradox or a puzzle involving the concept(s) at issue, and to have them struggle towards a solution. By forcing the students to "work it out" without some authority's solution, you increase the likelihood that they will be able to critically assess theories when they are presented later. For example, students in a course on theories of truth might be asked to assess the infamous "Liar Paradox" (with instances such as 'This sentence is false'), and to suggest ways in which such paradoxes can be avoided. Introductory logic students might be presented with complex logic puzzles as a way of motivating truth tables, and so forth. In scientific fields you can present experimental data which seems to contradict parts of the theory just presented or use examples which seem to have features which support two opposing theories.

Role Playing - Here students are asked to "act out" a part. In doing so, they get a better idea of the concepts and theories being discussed. Role-playing exercises can range from the simple (e.g., "What would you do if a Nazi came to your door, and you were hiding a Jewish family in the attic?") to the complex. Complex role playing might take the form of a play (depending on time and resources); for example, students studying ancient philosophy might be asked to recreate the trial of Socrates. Using various sources (e.g., Plato's dialogues, Stone's The Trial of Socrates, and Aristophanes' The Clouds), student teams can prepare the prosecution and defense of Socrates on the charges of corruption of youth and treason; each team may present witnesses (limited to characters which appear in the Dialogues, for instance) to construct their case, and prepare questions for cross-examination.

Panel Discussions - Panel discussions are especially useful when students are asked to give class presentations or reports as a way of including the entire class in the presentation. Student groups are assigned a topic to research and asked to prepare presentations (note that this may readily be combined with the jigsaw method outlined above). Each panelist is then expected to make a very short presentation, before the floor is opened to questions from "the audience". The key to success is to choose topics carefully and to give students sufficient direction to ensure that they are well-prepared for their presentations. You might also want to prepare the "audience", by assigning them various roles. For example, if students are presenting the results of their research into several forms of energy, you might have some of the other students role play as concerned environmentalists, transportation officials, commuters, and so forth.

Debates - Students are assigned to debate teams, given a position to defend, and then asked to present arguments in support of their position on the presentation day. The opposing team should be given an opportunity to rebut the argument(s) and, time permitting, the original presenters asked to respond to the rebuttal. This format is particularly useful in developing argumentation skills (in addition to teaching content).

Games - Many will scoff at the idea that one would literally play games in a university setting, but occasionally there is no better instructional tool. In particular, there are some concepts or theories which are more easily illustrated than discussed and in these cases, a well-conceived game may convey the idea more readily. For example, when students are introduced to the concepts of "laws of nature" and "the scientific method," it is hard to convey through lectures the nature of scientific work and the fallibility of inductive hypotheses. Instead, students play a couple rounds of the Induction Game, in which playing cards are turned up and either added to a running series or discarded according to the dealer's pre-conceived "law of nature." Students are asked to "discover" the natural law by formulating and testing hypotheses as the game proceeds.

https://teaching.berkeley.edu/active-learning-strategies

Individual plus Group Quizzes

Give students a quiz that they complete individually and turn in to be graded. Immediately following the individual quiz, put students in small groups and have them take the quiz again, but this time they discuss the answers in their group and turn it in for a group score. Both quizzes are graded and if the group score is higher, the two grades are averaged. The group score can't hurt someone if they have a higher individual score. This encourages individual accountability, and also helps students to better understand the material as they discuss it with peers. In this way, they keep up with the material, rather than realizing they don't totally understand it when they reach the midterm.

Jigsaws

Students work in small groups to read information that has been organized into sections. Each student in the group reads one section of the material and then shares that information with the rest of their group. As they read and share information, they refer to prompts such as: What do you think each idea means? What is the big idea? How can this idea be applied to help understand the concept(s)? What questions do you have about what you read? What do you agree/not agree with?

There are various permutations of jigsaws. One such model includes expert and cooperative groups: Each group can be assigned a particular aspect/part of the overall information – they read it individually and then discuss in their small "expert" group to make sure they all understand it. Then new "cooperative" groups are formed made up of one-two students from each of the original expert groups. In this way, the new groups have an "expert" representative from each of the original groups so that all of the information is now represented in the new cooperative group. The "expert" has had a chance to practice sharing and hearing other viewpoints about the

information in their original group, and therefore likely feels more comfortable sharing in the new group.

Partial Outlines/PPTs provided for lecture

Research has shown that students have a better understanding, do better on exams, and stay more engaged with the content during lecture when they are provided with partial, rather than complete lecture notes or PowerPoints.

Posters & gallery walk

Give groups of students an assignment that they need to work on together and present their ideas on a sheet of chart paper. Once they have completed their poster, have them display it on the wall, much like at a scientific poster session. One of their group will stay with the poster and help to explain it as the class circulates to look at all of the posters. Students take turns standing by their poster so that each of them have the chance to visit the other groups' posters. This sets up a more interactive way of presenting as compared to ppt presentations.

Fish bowl

A fish bowl allows a small group of students to engage in a discussion about ideas or concepts that have alternative explanations while the rest of the class observes and takes notes. An inner circle of students engages in the discussion, while the rest of the class either sits in an outer circle, or remains in their regular seats and observes. If you have your class organized into small groups, then the members of each group can tap their respective teammate and replace them in the inner circle to expand on or provide additional evidence to support an explanation. Optional: the entire class needs to take part in the inner circle conversation by the end of the class period.

Idea line up

The idea line up is a structure that allows a teacher to use the diversity of perspectives in the classroom to generate heterogeneous groups of students for discussion. This diversity of thinking is a good place from which to develop a classroom climate that supports argumentation. More student-initiated science talk happens when students are connected with peers who have opposing perspectives (Clark & Sampson, 2007). The question should be one about which students have enough prior knowledge/experience to have some evidence to bring to bear in the discussions which ensue.

How it works: The teacher provides a question that (s)he knows may have a continuum of responses, especially if it is asked prior to collecting significant amounts of evidence or before students have the opportunity to synthesize the evidence they have already collected.

The question is displayed prominently for students to consider. Students are directed to position themselves on a line to indicate their level of agreement in response to the question. After the

students line up, have students talk to the person next to them so they can clarify their own thinking on why they positioned themselves on the line in a particular spot.

Student positions on the line typically indicate a diversity of thinking. The teacher can then use their positions to form groups of students with differing ideas about the question. Students then discuss their thinking and reasoning for their responses with the peers with whom they have been matched. Students should be prompted to listen carefully to each other's claims and evidence and respond with evidence to counter or support the claims of other students in their group. A group claims and evidence chart or small whiteboards can be used to collect student thinking.

If the activity is used prior to an investigation, students can use the ideas from the initial discussion to continually weigh against the evidence they gather from their investigations. If the activity is used after an investigation, but prior to a whole-group meaning-making discussion, ideas from the small group discussions can be used to prepare for a whole group discussion.

Where do you stand?

Good for assessing attitudes when there's three or four likely responses. Pose a question to your students with three or four possible responses. Have them physically move and stand in the area of the room where you have on the wall large sheet of paper or where there's a white board with the answer atop. Instruct them to go around in their groups and each person shares the reason(s) why they hold that opinion. One person is to record the different responses. Each group then shares out. When that ends, ask if anyone wants to "defect" and join another group's opinion.

Four corners

Four corners is used for the same reasons as the idea line up. The only difference is that students are considering several claims (responses to a question). For example, a teacher might ask, "Where does most of the mass in a plant come from?" Claims for consideration might include, "soil," "air," "water," and "sunlight."

How it works: The teacher displays the question prominently for all to consider. Each corner of the classroom is assigned one claim, also prominently displayed. Students are asked to go to the corner of the classroom that has the claim they agree with most. If they think more than one answer is correct, they should just pick one of the corners they agree with. If they don't agree with any claims, they should go to the middle of the room. Once in their corners, students should discuss with others why they chose that corner to help clarify their thinking. Have them share and record evidence that supports that claim and why the other claims are not supported. Optional: have them visit the other corners to see what others thought about the ideas and the evidence they put forth.

Just as in the idea line up the teacher can use the student positions around the room to form groups with a diversity of ideas. The rest of the instructions are the same as for the idea line up.

For information about incorporating technology into your class, which can help with the incorporation of active learning strategies, check out Incorporating Technology into Your Teaching.

https://cft.vanderbilt.edu/guides-sub-pages/active-learning/#tec

The Pause Procedure— Pause for two minutes every 12 to 18 minutes, encouraging students to discuss and rework notes in pairs. This approach encourages students to consider their understanding of the lecture material, including its organization. It also provides an opportunity for questioning and clarification and has been shown to significantly increase learning when compared to lectures without the pauses. (Bonwell and Eison, 1991; Rowe, 1980; 1986; Ruhl, Hughes, & Schloss, 1980)

Retrieval practice—Pause for two or three minutes every 15 minutes, having students write everything they can remember from preceding class segment. Encourage questions. This approach prompts students to retrieve information from memory, which improves long term memory, ability to learn subsequent material, and ability to translate information to new domains. (Brame and Biel, 2015; see also the CFT's guide to test-enhanced learning)

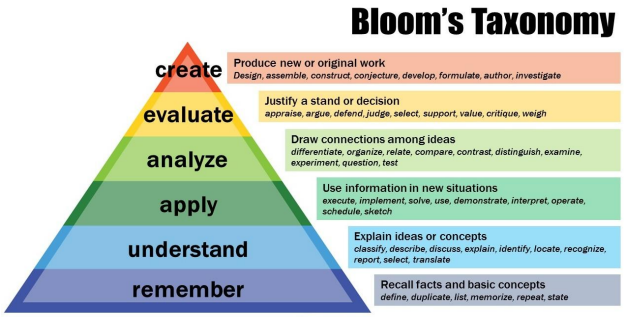
Demonstrations—Ask students to predict the result of a demonstration, briefly discussing with a neighbor. After demonstration, ask them to discuss the observed result and how it may have differed from their prediction; follow up with instructor explanation. This approach asks students to test their understanding of a system by predicting an outcome. If their prediction is incorrect, it helps them see the misconception and thus prompts them to restructure their mental model.

Strip sequence—Give students the steps in a process on strips of paper that are jumbled; ask them to work together to reconstruct the proper sequence. This approach can strengthen students' logical thinking processes and test their mental model of a process. (Handelsman et al., 2007) An example from Aarhus University is provided below.

Example strip sequence from Aarhus University *Organize the following events that occur during respiration in the correct order. Specify on your final sequence the names of the major steps to which these events correspond. If an event does not occur during respiration, eliminate it.*
O_2 is reduced to H_2O.
Polymers are digested into monomers.
The oxygen atom of H_2O is lost as waste in CO_2.
A lot of ATP molecules are made.
CO_2 is released as a waste product during oxidation of pyruvate.
Protons go from the intermembrane space to the matrix.
Pyruvate is transported into the mitochondrion.
NADH gives away its electrons and a proton gradient is created.
ATP molecules are formed in the cytosol and NAD^+ is reduced.

Mini-maps. Mini-maps are like concept maps, but students are given a relatively short list of terms (usually 10 or fewer) to incorporate into their map. To use this approach, provide students a list of major concepts or specific terms and ask them to work in groups of two or three to arrange the terms in a logical structure, showing relationships with arrows and words. Ask groups to volunteer to share their mini-maps and clarify any confusing points. Mini-maps have many of the same strengths as concept maps but can be completed more quickly and thus can serve as part of a larger class session with other learning activities. (Handelsman et al., 2007)

Categorizing grids. Present students with a grid made up of several important categories and a list of scrambled terms, images, equations, or other items. Ask students to quickly sort the terms into the correct categories in the grid. Ask volunteers to share their grids and answer questions that arise. This approach allows students to express and thus interrogate the distinctions they see within a field of related items. It can be particularly effective at helping instructors identify misconceptions. (Angelo and Cross, 1993)



Student-generated test questions. Provide students with a copy of your learning goals for a particular unit and a figure summarizing Bloom's taxonomy (with representative verbs associated with each category). Challenge groups of students to create test questions corresponding to your learning goals and different levels of the taxonomy. Consider having each group share their favorite test question with the whole class or consider distributing all student-generated questions to the class as a study guide. This approach helps students consider what they know as well as implications of the instructor's stated learning goals. (Angelo and Cross, 1993)

Example for a biology class
(from Handelsman et al., 2007)

You are the head of a major blood bank, and there is a worldwide blood shortage. You are offered a shipment of blood that might be contaminated with a new retrovirus that has not been well studied. Will you allow the blood to be used? Why? What would you like to know before you make your decision?

Decision-making activities. Ask students to imagine that they are policy-makers who must make and justify tough decisions. Provide a short description of a thorny problem, ask them to work in groups to arrive at a decision, and then have groups share out their decisions and explain their reasoning. This highly engaging technique helps students critically consider a challenging problem and encourages them to be creative in considering solutions. The "real-world" nature of the problems can provide incentive for students to dig deeply into the problems. (Handelsman et al., 2007)

Content, form, and function outlines. Students in small groups are asked to carefully analyze a particular artifact—such as a poem, a story, an essay, a billboard, an image, or a graph—and identify the "what" (the content), the "how" (the form), and the function (the why). This technique can help students consider the various ways that meaning is communicated in different genres. (Angelo and Cross, 1993)

Case-based learning. Much like decision-making activities, case-based learning presents students with situations from the larger world that require students to apply their knowledge to reach a conclusion about an open-ended situation. Provide students with a case, asking them to decide what they know that is relevant to the case, what other information they may need, and what impact their decisions may have, considering the broader implications of their decisions. Give small groups (3-5) of students time to consider responses, circulating to ask questions and provide help as needed. Provide opportunities for groups to share responses; the greatest value from case-based learning comes from the complexity and variety of answers that may be generated. More information and collections of cases are available at the National Center for Case Study Teaching in Science, the Case Method Website of UC-Santa Barbara, and World History Sources.

Discussion techniques

Many faculty members dispense with lecture altogether, turning to discussion to prompt the kinds of thinking needed to build understanding. Elizabeth Barkley provides a large collection of discussion techniques focused on different learning goals, ranging from lower level to higher level thinking (Barkley, 2010). The CFT's Joe Bandy has summarized some of the most useful of these techniques.

Other approaches

There are other active learning pedagogies, many of which are highly structured and have dedicated websites and strong communities. These include team-based learning (TBL), process-oriented guided inquiry learning(POGIL), peer-led team learning, and problem-based learning (PBL). Further, the flipped classroom model is based on the idea that class time will be spent with students engaged in active learning.