

## Active Learning Transcript

Hi, welcome to engaging students via active learning. My name is Hannah Allen and I am a current sixth year graduate student in chemistry at Caltech. And today I'm going to be covering different ways that you as a TA or as an instructor at Caltech can really engage students in your classroom using active learning.

So in this video, I'll go over a couple things. The first is to answer the question: "What is active learning?". Then we'll dive into a bunch of different techniques that you can use and you can implement in your classroom. And those will be divided into three separate categories. The first category is the quick and simple techniques. These are the ones that are the easiest to use, that can be used with very limited preparation and can be done on the spot, if needed, and a really good starting place if you have never really used active learning in the classroom.

Then we'll move on to the second set of techniques which are the moderate planning techniques that require a little bit more preparation ahead of time. And then finally we'll delve into the more complex set of active learning techniques and these are really great ones to use and really enhance student learning, but it might be a little bit more involved and require a bit more preparation ahead of time. And then finally we'll cover a little bit of follow up and some resources at the end of the video.

So the goal is, by the end of this video, that you will understand what active learning is and maybe a little bit about why it's important. That you will be able to identify active learning techniques different situations that you can use those techniques in and that hopefully you will feel more comfortable implementing active learning in your own teaching.

So what is active learning? Active learning in essence is any educational method in which all students are asked to engage in the learning process while in the class.

So this means that students are not passively receiving information. An example of students being very passive in the classroom is a traditional lecture in which students are sitting and simply listening to information that is being presented to them and maybe taking notes, but not really doing much beyond sitting and listening and writing. What they're - writing what they're hearing.

So in active learning, we really want students to participate in their own learning. Hence the active component of active learning. And active learning is a way of treating learning, not as a product or as a set of facts to be memorized, but instead as a process, as a way to engage and problem solve in a particular field and whatever subject the class is being taught.

So there's a lot of research about how active learning is beneficial to students. All that research points to that students retain more information and they perform better on exams when active learning is used in the classroom than when it's not used in the classroom. And I'm not going to go into detail about that research, simply because of time constraints. But if you are interested

in learning more, you can Google, there's a lot of information on the Internet or you can visit the CTLO and they can give you a lot of resources if you're interested in that research behind that pedagogy.

But some things to consider when you are using active learning classroom is that you also have to be active. If you are asking students to engage you also have to engage. And one - another thing to consider is that it might require a little bit more instructor preparation or involvement than might be required in traditional lecture. This is particularly true if this is the first time that you are really implementing active learning. It takes a little bit of time to figure out exactly how to ask questions or how much time to allow students to really engage with the material and make sure that they're getting the most out of it.

One criticism that I have often heard of active learning is that you potentially cover less material. And while that may be true in terms of you are presenting less material to class or they are being confronted or memorizing less material, Again, you have to think of active learning as a process. And so you may cover less material, but you are teaching students the tools that they need to learn more and be able to do more on their own in the field that you're presenting to them. And active learning spans a whole range of activities from just a few minutes in the class to an entire class period devoted to active learning. So it's okay, especially if you are relatively new to active learning to mix lecture and active learning techniques and incorporate both into the lesson.

And finally, something to consider when doing teaching at all, and in particular when doing active learning teaching is purpose, process, and product. And by that I mean, thinking about the purpose of that activity, what you are asking students to do and why you're asking students to do it. The process: So what is it that you want students to actually do? What steps do they follow? And finally, the product. How will students show you that they have engaged or that they have learned the material that you asking them to learn. These are the three types of questions to ask as you design active learning techniques into your lesson plan.

So first the quick and simple, easy to use, on the spot, type of techniques. And these will be brainstorming; think, pair, share; and minute paper. So brainstorming is the most common active learning technique and is probably the one that most students have had exposure to. It's really good because it requires very little preparation, it can be used as a way to assess prior knowledge at the beginning of a lesson, and it's a great way to get students talking if they seem disengaged are really quiet or there's something that's distracting them.

So this technique works by asking students a question, having students call out answers and respond in some way, and then having the instructor collect those answers into a class list. And brainstorming can be adjusted for any length of time, whether it's just having a few students participate, having students just call out, the ones that are a little more comfortable calling out, or whether you really have them generate a really long list and go more to delve more deeply into that question that you're asking the students.

Finally, it's really important to acknowledge answers when you're doing brainstorming, just to make sure that you know that all students are participating. This can be as simple as a thank you when hearing a response or making sure that you're really writing down every student's response as they're calling out. So an example of a brainstorm technique would be: "what active learning strategies have you experienced as a student?" So then you can pause the video, a minute, if you like, and just jot down all of the different techniques that you can that come to mind when you think of the active learning strategies that you have personally used.

So in a classroom, we would then have the students respond and call out their different active learning techniques that they used and so good way to generate that list is either via a whiteboard in which the instructor writes down what they hear the students respond or you can use PowerPoint slides and generate a list by typing out what you're hearing students respond. If you're online, this can be done in a chat box or on a shared document that the students can see. And again, you're recording the list of the different things that you hear students respond.

So the second technique is the think, pair, share. This is really useful technique if you ask a student of the - Ask a question of the class and are met with a bunch of silence and no responses. It's a great way to get students talking without being intimidated by having to raise their hand and in front of the whole class all at once.

This works by asking students a question, giving students time to either think or write, then pairings students with a neighbor to discuss their responses and having those pairings share their discussion with the whole class to generate a class discussion.

One thing to consider is to set timing guidelines. So for example, you have students think for 30 seconds, pair for two minutes, and then share. It's a good way to just allow students to gauge how much time they should be spending answering these questions.

So, a typical question that I might use in the context of this video is the same question from the brainstorming session. In which case I will, I am asking you, or whoever's watching "what active learning strategies have you experienced as a student?"

And if this was in the classroom. I would give you a few minutes to think, you can pause the video and jot down some answers for you would like, and then I would have students turn to whoever is near them. And then we would collect those responses as a class. So again in - in person class. This might be done simply by a class discussion, that's a pretty good way of making sure that you're collecting a bunch of different answers and just having people discuss. This is a little more difficult in an online environment, simply because of the way the technology setup. But if you are online, you can do this by the think share method which is the "flood the chat" method in the chat box. This is where you have students write down their responses, but don't hit "enter", don't send it to the public space. And give students a minute or so to write down their responses and then have all the students submit all of their responses all at once.

And so you get a very quick generation of ideas in the chat. You can also have, if you want to include that pair component. You can have students direct message each other and just chat via text a few times for a few minutes, or you can in the Zoom platform send students in pairs to breakout rooms which gives them a space away from the main class discussion to discuss their ideas.

So the final some quick and simple techniques that I'm going to cover is the minute paper which might also be referred to as a reflection paper.

So this is an assessment, a great assessment determine how students are learning and how much they're learning, how they feel about what they're learning. It's usually done at the end of the class period or unit, but could also be done at the very beginning of a class unit or period if you're interested in assessing prior knowledge. And it works by having asking the students a very open ended question that prompts them to reflect on the lesson and then give students a few minutes, maybe five minutes, to write a response and just free think about what how they would answer that question.

It's important to avoid yes no questions, these questions are meant to be designed to get students to really think about what they're learning and reflect.

So an example of a question for a minute paper might be: "What are the two most significant things you learned today?" Or you could ask: "What is one item you still have a question about?" or you can even ask, if you're interested in prior knowledge, "What are some things about the subject you know already?" And so then that's a good way to either see what students have learned, what they think is important in what they're learning, or maybe what students are not understanding, or what they might already know about the topic.

So now we're going to move on to part two, the moderate planning techniques. And these are going to be the things the techniques that I'm going to cover are the clicker questions. We're going to go over the one stage and two stage type of clicker questions. So clicker questions are really good for a few different reasons. You can use them to assess student prior knowledge if there is some prerequisite facts or knowledge that they should have that you're not sure if they have coming in, you can use quicker questions to assess that. And in particular, is really good way to get immediate feedback on the misconceptions and the current understanding of a class.

In quicker questions usually every student is required to respond. If you - depending on the technology you're recording those names may be linked to their response. So this is a good way to also get a participation, if you're interested in having students be present in the lecture and monitoring they're present in the lecture. This works by asking a question, and having them select from a list of possible responses. Each student then uses a clicker to select their answer and instructor receive those responses, and then instructor can provide further explanation or clarification as needed. And again, this is a great way to get immediate feedback, rather than waiting for a quiz or an exam to see if students are being able to solve problems and remember

the material that you are presenting. So an example in the context of this video of a good clicker question might be: "What are some quick and simple active learning techniques that we've gone over?" and then choose from the list presented here.

So clicker questions can be done as one stage, so what I presented was one stage, but they can also be done as a two stage process. A two stage process and is one that involves peer instruction. So that's when you have students talking with each other and helping each other through the learning process. It's the same setup as the one stage where, again, there's a question, student selects answers, students choose an answer. But then instead of - once students have selected an answer, instead of just revealing the answer you have students discuss with each other what they think the correct answer is, and then have them re-select their answer based on their discussions and then have that be their final answer. This two stage method is good because the number of students who answer correctly usually increases substantially in the second round of questions versus the first round as students really think a little bit deeper about the question that you're asking them.

And a good rule of thumb to follow is to make sure that in that first round of questions, the number of correct responses is between 30 and 70% of the class. If it was below 30%, usually too many of the students are confused and having them talk to each other won't generate any new knowledge or understanding. And above 70% most of the class is probably very comfortable with the material so having them discuss among themselves may not generate any new understanding. And having a two stage versus a one stage can be very beneficial because the two stage requires students to think about why they might have gotten an answer wrong and to take immediate and direct action to correct their mistake, rather than just letting it go, or moving on, without really thinking about it.

And students may be able to explain a little bit better to each other where something might be wrong, or where student might misunderstanding then instructor might just simply because they might use different language or they might, because they more recently learned it, might have a better understanding of all the steps that are needed to get to the correct answer.

Alright, so now that we've gone over some details of clicker questions, I'm going to go over a few technologies that you can use to generate have students respond and generate those responses.

So in an in person classroom, there's a couple there's a range of techniques you can use that are low cost or very cheap and easy to get such as colored papers, where a color corresponds to an answer so "red" for "a", "blue" for "b", etc. You can have students raise their fingers. So if the answer has "1,2,3, or 4" have students either raise their hand up high Or if students want to be a little bit more anonymous, have students put the correct response or their response up closer to their chest so the instructor can see it, but maybe other students aren't - it's not as visible to other students.

There are actual clicker devices that you can use that have some button that corresponds the answer that some students want to select. Or finally there are phone apps that do something similar. So Poll Everywhere is one that will connect to a student's phone and use the internet to transmit responses to the instructor's computer.

In an online classroom environment, there's already technology being used and so that makes these technology responses a little bit easier. So phone or computer apps such as Poll Everywhere.

Students can use a phone or use a browser to select their responses. Or most online learning platforms have some form of polling feature available. So, for example, Caltech tends to use zoom as an online learning platform and there is a polling feature available in zoom in the pro version that will be available to TAs and instructors.

So finally, some things to consider is the type of questions. So this can range from pretty quick, easy questions or questions that are a little bit more "yes, no", or a little bit more about remembering a fact all the way to questions that ask students to solve a math problem or use some equations. And just to give them a little bit more time if you are asking them to solve something on scratch paper and then transmit their answers.

So clicker questions are particularly good in large classes. It's a great way to get all students involved even ones who might be sitting in the back of the hall. Or questions where it can be maybe a little bit harder for the instructor to see every student, particularly if the answer is transmitted are tied to a student name.

And finally, just to remember that as an instructor once you use clicker questions to just leave a little bit of time in case topics need to be revisited or if you are a little surprised by student responses. And so just having a little bit of that time to go over the material in case there anything comes up when doing these clicker questions.

Finally, some things to consider are just the cost of technology, how much you are asking students to pay for these again there's kind of a range of free technologies to very - to more advanced technologies. So just keep that in mind. And then leave a little bit of time for testing before you walk into a classroom as with all technology.

So finally, we're going to cover a little bit a few of the more complex techniques. So these are the group problem solving and the extended problem solving. So in the group problem solving, it's a really impactful way to hold class discussions and promote peer instruction. It's really having students learning with each other and engaging with each other in the learning process.

These tend to be very open ended, and so definitely require some clear instruction and some clear follow up to make sure that all students are engaged and are on track and not kind of wandering off on some side path.

This works by having students, splitting students into small groups, typically around three or four students; having students work on a question, a problem, or some task; and then as the students are working, they record their reasoning, their steps, their ideas as they're going through, and then they might present their results to the class or have some form of class discussion after students have solved the problem.

If you're in an in person class a great way for students to record their steps is to use whiteboards, either ones that are mounted on the wall or handheld ones that can be used at tables or chairs. And if you're online, a few technologies that you can use are breakout rooms, particularly in the Zoom platform, having a shared document that all students can edit - that students all students in the group can edit, or some form of digital whiteboard.

An active learning technique that we can use is extended problem solving. So this is an example of a flipped classroom. And a flipped classroom is usually when students will engage in factual knowledge learning outside of the classroom by either watching a pre recorded lecture or by reading a textbook, and then come into the classroom and that's where they do all the problem solving component of learning. This is most common in large classes that have some form of breakout session where that might be a recitation or discussion sections. It's very common to use these kind of extended problem solving in those types of environments. And again, this relies on that peer teaching on having students really engage with each other in the learning process.

So this is the way it works is the same as the group problem solving session, instead of solving just maybe one problem, the entire class period is dedicated to solving maybe a series of questions or working on a big a large scale project, and so the entire session is dedicated to this peer instruction and this group work.

So it's really important when doing, particularly if the entire class is dedicated to extended problem solving, to have an instructor and the TAs circulating and interacting with different students.

It's really key to make sure that the instructor knows the pace that the students are going and making sure that they're on track to cover the amount of material that instructor wants covered and make sure that all students are engaged and on task and answer any questions that might arise during the process and really be there to guide the students.

And again, it's important for an instructor to at the end, have some form of follow up or review to make sure that because students may go at a different pace and different groups may be going faster or slower. And so just to kind of come back and make sure that everyone is on the same page at the end of the lesson.

So finally, some things to consider is, again, ensuring as an instructor, ensuring that everyone is active and participating. So a few ways to do this are to have smaller groups usually three or four students is good and any more than that can mean that some students don't get to

participate. And if they're if you are noticing as an instructor that not enough students are participating, you can assign group roles, in which case every student then has an individual thing that they are in charge of that helps promote the group learning and allows each student to really focus on doing a particular thing in the context of a group.

Another thing to consider is whether you want to change groups throughout. If you decide to do extended problem solving throughout an entire term whether you want to change group members and allow a lot of diversity of thought and opinion. Or whether to keep the same group members throughout the entire term which enables students to have a little bit more anticipation of what the class is going to look like and reduces time spent doing logistics as students try figure out their groups.

So finally, I want to just leave you with a note about instructors role in active learning. And the way I view this is that instructor moves from being the authority figure, from being that figure who stands in front of the classroom, who has all of the knowledge is simply giving their knowledge to the students; to with active learning the instructor being a guide, someone who's helping students learn the process of learning, learning the process of problem solving and helping students learn how to learn on their own, given the nuances or the techniques that are common in whatever field that instructor is teaching.

Finally, there's several resources available to you as an instructor or a TA at Caltech. The CTLO is a fantastic resource and is always available for whatever you might need. And you can also visit [teach dot Caltech dot edu](http://teach.caltech.edu) for more resources on teaching remotely or [learn dot caltech dot edu](http://learn.caltech.edu) for more resources on learning.

Thank you so much for watching this video. Bye.