Effective Engineering "Teaching" in Practice
Prof. G. K. Suraishkumar
Department of Biotechnology
Indian Institute of Technology, Madras

Lecture - 08
Flipped Classroom

Welcome back. We are doing the course Effective Engineering Teaching in Practice and we have looked at various different topics so far. Today let us start looking at something called a flipped classroom. If you look at the broad scheme of things, this is also active learning and so on so forth, but it is a specific kind of active learning. Active learning just means that the students are engaged in their learning process, they are not just passive listeners, they are engaged in the learning process.

Active learning is an important aspect of this flipped classroom, but the dynamics is very different. Let us look at what it is.

What exactly is a flipped classroom?

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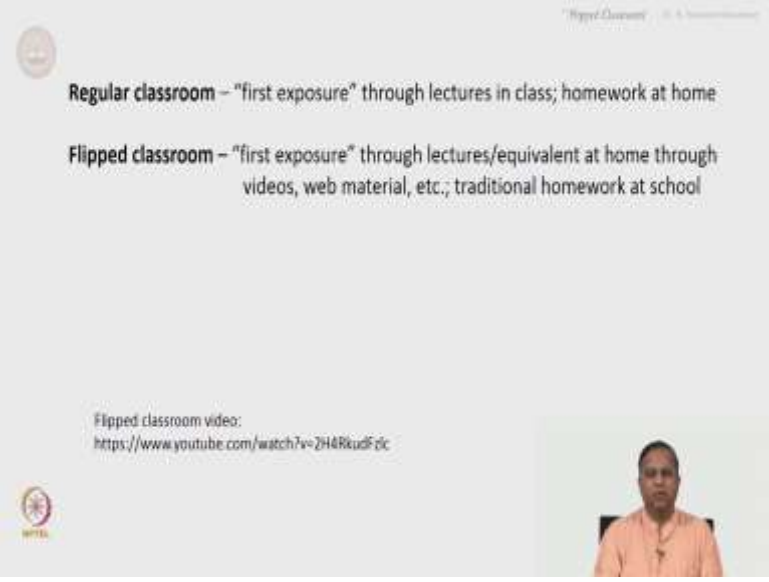

It is something like this. In a regular classroom, the first exposure to the material through lectures happens in class and then the reinforcement of the material that is learnt comes through homework which is done at home, in the hostels and so on so forth. That is the typical way things have been done for a very very long time. And the flipped classroom

just flips it around. In this case, the first exposure through lectures or equivalent happens at home through videos web material and so on so forth, and what was traditionally called the homework you know exercises, discussions and things like that, discussions would be an addition, the exercises and the engagement of the student with the material and so on so forth, this now happens in the classroom. This is the flipped nature of things.

I can immediately guess that you would be thinking - how is this really going to work. I mean how would they be exposed to the material, how would they be engaged in the classroom if they come with exercises, how many people are going to really read the material beforehand and so on so forth, let us look at all those things one by one and ways of handling them.

Before we go further, it might be helpful for you to watch this video that is given here, the flipped classroom video. A nice example of a flipped classroom. It will give you an idea of what the flipped classroom actually is, how it is done and then let us come back and look at it. I cannot play the video here, but you can always go and watch these videos which are available to everyone.

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The, assuming you can go and watch that later offline, the article by Eric Mazur who was a popular teacher in highly reputed journal science that was published way back in 2009. This provided some very interesting insights about the flipped learning. Eric Mazur has

done very many different things for a very long time. It was known way back in 1991 that he was trying these things, some people say that the flipped classroom can be attributed to him, but he comes from a very many different angles and flipped classroom seems to be attributed to him.

We looked at one of his videos, hopefully you looked at one of his videos that was recommended for the co-operative group learning session or the chapter, it is pretty much the same person. The first person, that video on the physics course. Let us look at the article that he wrote in science in 2009 to understand where he is coming from. As you realize he is coming from various different angles down to this particular aspect of a flipped classroom.

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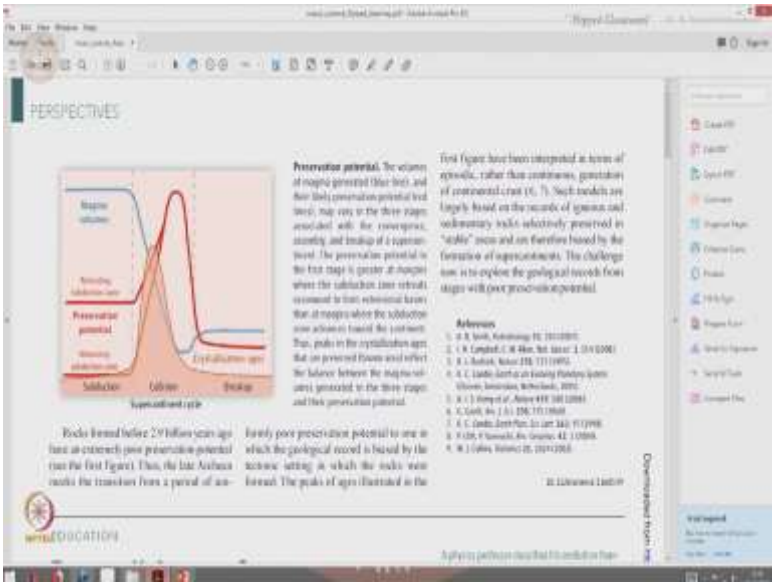

This is the journal here, it is a perspective in education in science, published in science. Farewell lecture, essentially means bye bye lecture.

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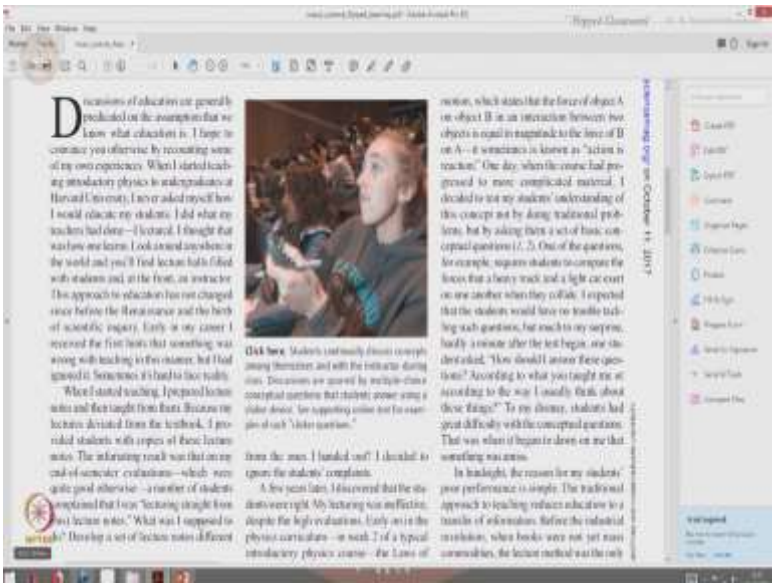

A physics professor describes his evolution from lecturing to dynamically engaging students during class and improving how they learn, that is what is given here, I need to point this out. Let me read out some parts of it, it is a very nicely written article. Let me read out some parts of it and then you would understand what it is all about or what the motivations are. Discussions of education, I am starting somewhere here right, discussions of education are generally predicated on the assumption that we know what education is.

I hope to convince you otherwise by recounting some of my own experiences. When I started teaching introductory physics to undergraduates at Howard University, I never asked myself how I would educate my students. I did what my teachers had done, I lectured. I thought that was how one learns. Look around anywhere in the world and you will find lecture halls filled with students and at the front, an instructor. This approach to education has not changed since before their renaissance and birth of scientific enquiry.

Early in my career, I received the first hints that something was wrong with teaching in this manner. But I had ignored it, sometimes it is hard to face reality. I am going to read only parts of this. When I started teaching, I prepared lecture notes and then taught straight from them. This is what he did. I will switch to here. A few years later I discovered that the students were right, the students had made some comments and he says students were right, my lecturing was ineffective, despite the high evaluations. Early

on in the physics curriculum, in week two of a typical introductory physics course, the laws of motion which states that the force of object a on object b in an interaction between two objects is equal in magnitude to the force of b on a, it sometimes is known as the action is reaction.

One day when the course had progressed to more complicated material, I decided to test my students understanding of this concept, not by doing traditional problems but by asking them a set of basic conceptual questions. Herein comes the crux by, but by asking them a set of basic conceptual questions. One of the questions for example, requires students to compare the forces that a heavy truck and a light car exert on one another when they collide. I expected that the students would have no trouble tackling such questions, but much to my surprise hardly a minute after the test began, one student asked how should I answer these questions according to what you taught me or according to the way I usually think about these things.

To my dismay students had great difficulty with conceptual questions. That was when it began to dawn on me that something was amiss. And so on and so forth let me read out the relevant, excuse me the relevant parts.

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Since this agonizing discovery, I have begun to turn this traditional information transfer model of education upside down. The responsibility for gathering information now rests squarely on the shoulders of the students. They must read material before coming to

class. So, that class time can be devoted to discussions, peer interactions and time to assimilate and think, very powerful things here. So that class time can be devoted to discussions, peer interactions - this is very powerful and time to assimilate and think. Instead of teaching by telling, I'm teaching by questioning.

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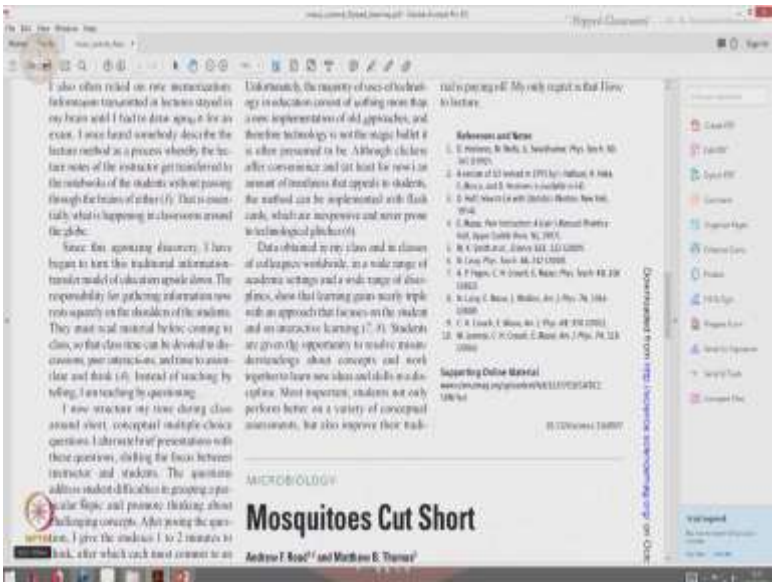

I now structure my time during class around short conceptual multiple choice questions. I alternate brief presentations with these questions, shifting the focus between the instructor and students. The questions address student difficulties in grasping a particular topic and promote thinking about challenging concepts. After posing the question, I give the students one to two minutes to think after which each must commit to an individual answer. They do this by submitting their answers using hand held devices called clickers, you could use other things, nowadays there are apps for clickers on which students can download on their cell phone and you can connect it to your system and you can view, assuming you have a computer system. Because of the popularity of these devices questions posed this way are now referred to its clicker questions.

The devices transferred the answers to my computer which displays the distribution of answers, this is also shown in the video by the way, the YouTube video which was recommended viewing for the cooperative learning chapter. The devices transfer the answers to my computer which displays the distribution of answers. If between 35 percent and 70 percent of the students answer the question correctly, I ask them to

discuss their answers and encourage them to find someone in the class with a different answer, you see the concept of think peer share that is coming in here.

Together with teaching assistants, I circulate among the students to promote productive discussions and guide their thinking. After several minutes of peer discussions, I ask them to answer the same question again. I then explain the correct answer and depending on the student answers may pose another related question or move on to a different topic, it has become dynamic and the only motivating factor is how much the students have understood, how much of the concept the students have understood. This approach has two benefits - it continuously actively engages the minds of the students and it provides frequent and continuous feedback to both the students and the instructor about the level of understanding of the subject being discussed and so on and so forth.

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You could read this paper, it is available to you.

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And finally, let me read out this par,t data obtained in my class, I am somewhere here now, you could read this. Data obtained in my class and in classes of colleagues worldwide in a wide range of academic settings and a wide range of disciplines, show that learning gains nearly triple with an approach that focuses on the student and on interactive learning, this is what we have been trying to get across. And this is well supported by evidence, evidence based.

Students are given the opportunity to resolve misunderstandings about concepts and work together to learn new ideas and skills in a discipline. Most important - students not only perform better on a variety of conceptual assessments, but improve their traditional problem solving skills. Also data show that such interactive engagement helps to reduce the gender gap that exists in an introductory physics classroom - this is in 2009. So, evidence is mounting that readjusting the focus of education from information transfer to helping students assimilate the material is paying off and finally, humorously he says, my only regret is that my love to lecture. So, you might want to read this a couple of times to internalize it. Now, let us move forward.

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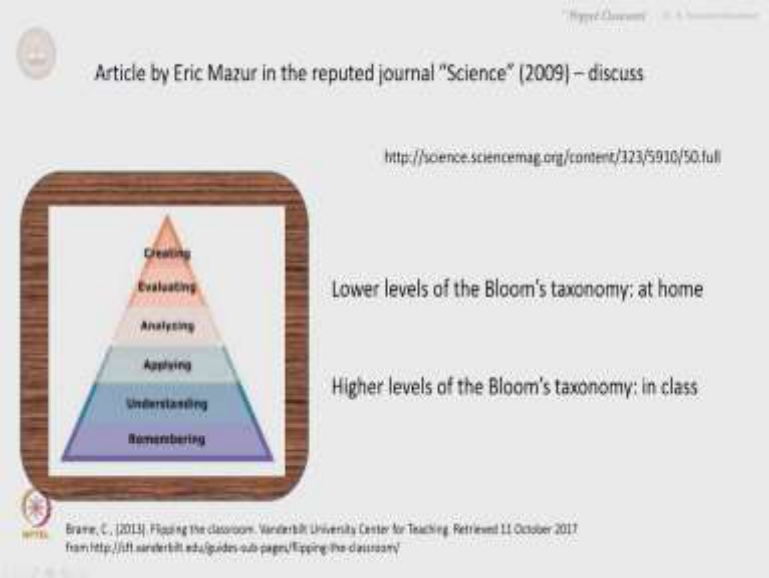

This is what we discussed - the short article in the perspectives in the journal science published in 2009.

When you learned about Bloom's taxonomy, you might have seen this figure in some form of the other somewhere I did not exactly show this figure earlier, it is an oft used figure, this particular figure I have taken from the source that is given here. As you can see here, the remembering the basal level or nowadays we use verbs to remember, to understand, to apply, to analyze, to evaluate and to create or design - the various levels of the Bloom's taxonomy from the most surface level to the deepest level. What happens here in the context of flipped learning is that the lower levels of the Bloom's taxonomy, mostly remembering aspect you know and information, you need to remember some

information, that gets covered and probably some level of understanding gets covered at home when they are exposed to the material for the first time.

And then they come back to class and the higher levels of the Bloom's taxonomy- applying, analyzing, typically maybe some evaluating and if we give them some time, maybe even creating can be achieved in class and therefore, the higher levels of the blooms taxonomy are taken care of in class and the lower levels of Bloom's taxonomy are taken care of at home when they are exposed to the material for the first time. This is the overall principle of flipped classroom. Let us see the nitty-gritties of how to do this.

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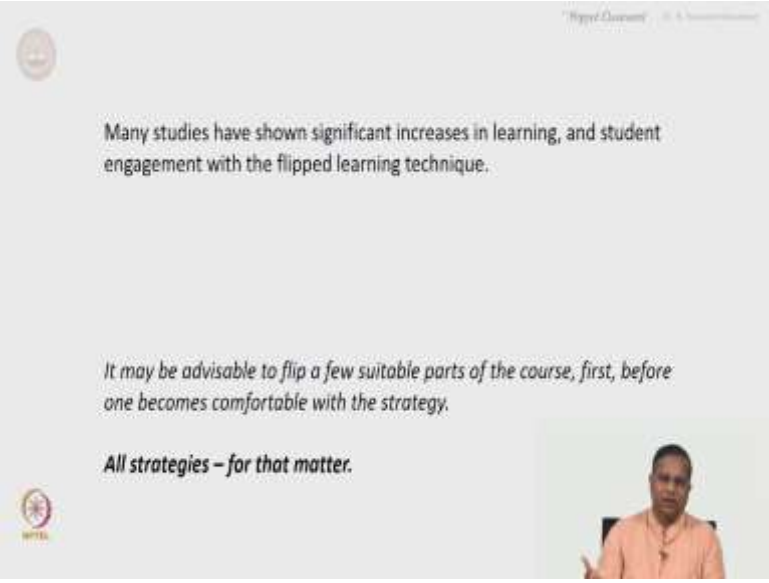

Before that, many studies have shown significant increases in learning as was mentioned in Eric Mazur's article and student engagement and learning increases with the flipped learning technique.

And this is for us, who are trying it out for the first time, it may be advisable to flip a few suitable parts of the course first before one becomes comfortable with this strategy. This is always a good thing to do in whatever strategy that you try out for the first time, it is good to do some parts of it, try it out in some parts of the lecture, not cover the entire lecture completely go all the way, that is what is recommended by some over enthusiastic administrators. It might be not so good to do that. Do some parts of it, feel comfortable with it and slowly get into it and if you really feel the need for flipping the

entire lecture, then go ahead and do it, you will be comfortable in doing it, but do some parts of it first.

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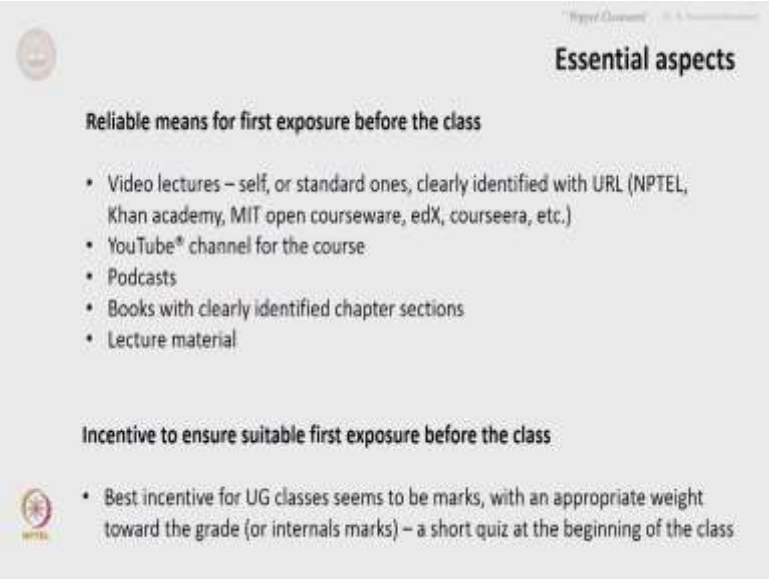

The essential aspects, these are the nitty gritty details that I was talking about. There must be a reliable means for first exposure before the class. This is a very big responsibility, the instructor needs to be very clear to the students, must very clearly communicate to the students, where to find the information, what exact material to be read and probably remembered, understood and so on so forth. And that happens to be very clear, we cannot be fussy about this. There will be a big temptation to say go and look at this, go and read this without giving the specifics and that is not really done. You will have to give very specific video, very specific information about what to cover. That is very crucial.

The video lectures for example, it they could be self lectures, may be you have recorded some or I mean you could have a YouTube channel for your own, may be you have recorded some videos through your institute for that, that you could use or you could use standard ones with you must identify the URL very clearly. They could be from either the NPTEL source itself or Khan academy which has very, some very nice lectures, MIT open courseware is an another example, edX coursera are other examples and there are very many different sources that are available to us today from the video lecture point of view. This could be used for the first exposure of the student at home, but it needs to be

very clearly mentioned which particular aspect they need to look at, which particular video they need to look at or which particular part of the video they need to look at.

The information that you are looking at may or may not be available in this form. If it is available, then this can be used otherwise, it is an opportunity for you to create your own video nicely. YouTube channel for the course can be maintained and the videos that you create can be put in there and used as first exposure material. Podcasts have been used they could be used. Books with clearly identified chapter sections must be used. A very standard excuse or feeling of some instructors saying you go and read this book and then come back, that is not done. You go and say - this chapter, this section for this particular lecture you come back prepared and for every lecture you need to give them that.

The lecture material can also be made available, through various means and most importantly, this is important in terms of the nitty gritty, if you tell them to read and come, the usual experience across the world, I have asked very many people this question, how many of your students, what percentages of your students actually read the material if you do not follow it up and so on. So, the percentage varies anywhere from 10 percent to up to about 40-50 percent, that has been the best. Students are students and they will try to optimize their time. If there is nothing pressing, they are not going to read the material and your entire strategy goes down the drain because they are not reading the material.

And therefore, what usually works to ensure that they read is to give them a suitable incentive. Incentive to ensure suitable first exposure before the class that can be done typically by a short quiz at the beginning of the lecture on the material that they were supposed to have read before coming to class. This is good enough and if you give them about ten percent weightage for those quizzes toward the final grade or internal marks you know if you do not have grades, if you have university system where you have an external and internal marks kind of a system. Then you could link the internal marks to this and that works wonders you know, marks are a very big incentive for undergraduate students. And even if you do not believe in exams in marks you could use this as incentives. So, as the learning improves through the flipped classroom technique.

So, the best incentive for UG classes seems to be marks with an appropriate weight towards a grade or internal marks and usually a short quiz at the beginning of the class is good enough.

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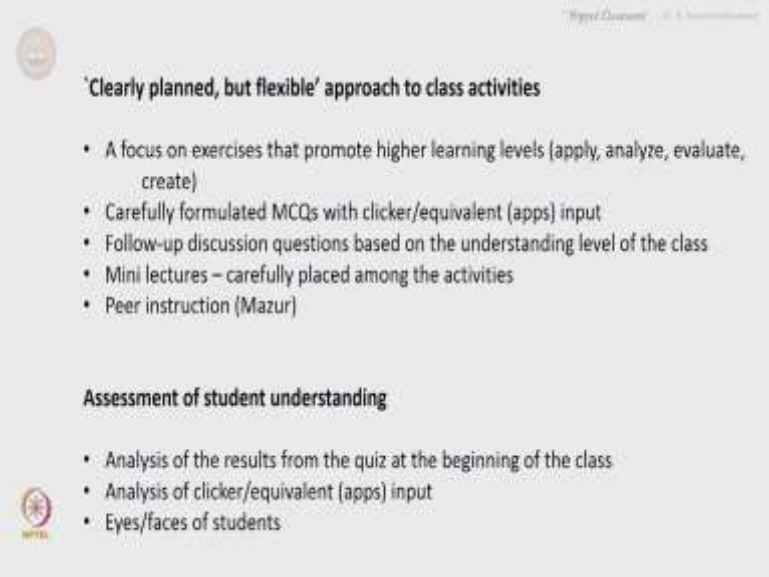

It is good to have a clearly planned, but flexible approach to class activities. You know what you need to do, but you need to kind of change locally to address what is happening in class, that is what I mean by mean being flexible. You do not have to give up whatever you are trying to do. But you do not have to force whatever you are trying to do from point a to point b in a class when you are addressing the class in a flipped classroom technique. For that matter in any classroom, but here it becomes a lot more needed.

There has to be a focus on exercises that promote learning that you give in class, typically that test, apply, analyze, evaluate and create levels of the Bloom's taxonomy. Carefully formulated multiple choice questions, multiple choice questions need some careful formulation if they need to be effective, but once they are done that is very good you know. Associated probably, probably with clicker or equivalent input would give you a much better data to work with, much better view of the class, what percentages of the class is getting it and so on.

So, that is recommended even if you do not have the clicker thing, you could have your own means of them writing on chits of paper giving it back to you, that is only a

technological aid which improves it. Even if you do not have clickers, even if you are not set up for the appropriate apps to be downloaded on the cell phones and so on so forth you could use the old methods of writing on chits of paper to get that input. Only thing is that you will have to put in a little more work to get the distributions and so on, which needs to be done offline.

Follow up discussion questions based on the understanding level of the class needs to be prepared. Many lectures can be carefully placed along with the activities. Students have hopefully picked up the material, but you can reinforce the material through short lectures, maybe a few minutes and then go on to activities. Peer instruction as was ably demonstrated in the Mazur video. You could do that, you could present a question, you could ask students to work it out give you the input and then turn to their neighbors, talk to them if they need to improve their answers or change their answers based on the discussion they can do so and thereby the learning keeps on improving. This is the think pair share method, peer instruction method. In the words of Mazur, all this work very well.

Then finally, assessment of the student understanding needs to be done. Analysis of the results from the quiz at the beginning of the class should give you input. Analysis of the clicker or equivalent input methods apps or paper, that would give you some good input. And if you are a natural teacher or if you have a natural skill for teaching, the eyes and faces of the students are the best input that anyone can get assuming that you can read them. All this what went on in front is for anybody whether they have the natural skill or not to be able to get that input, that it what was discussed earlier.

Never doubt if you have a natural inclination, if you are able to read the eyes and faces of the students, that is the best thing. For anything for that matter in a class, I scan a class, I present a concept, I scan the class- just by the way they look at me, I know whether they have understood or not. If you have that skill, please use this, please augment it by all these methods, but never ever think low of that skill, that is the highest form. I would leave you with that and when we meet again we will discuss lab courses.

See you.