TALE - 2 Course Design and Instruction of Engineering Courses

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Lecture - 10
Development Phase

Greetings and welcome to Module 2 Unit 10 related to Development Phase of the Course Design.

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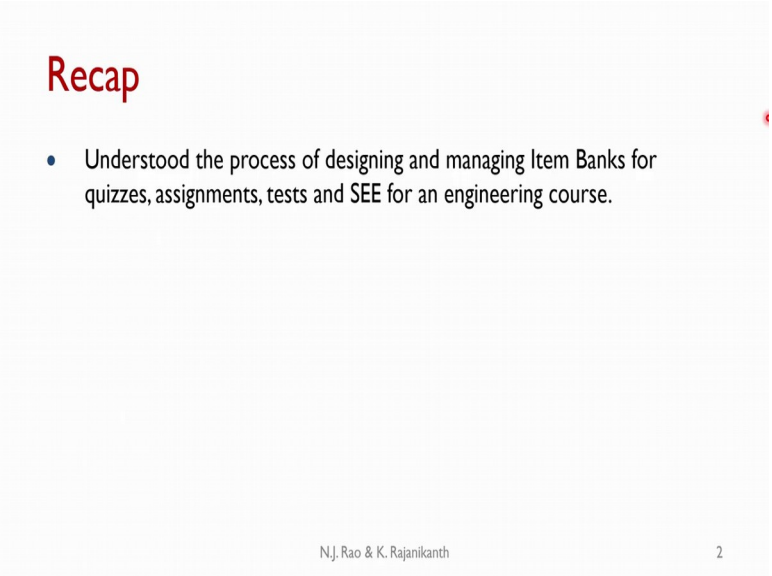

For the course design, we are following the ADDIE model. ADDIE model has Analysis Phase, Design Phase, Development Phase followed by Implement Phase and Evaluate Phase. While the activities that we have been looking at under the ADDIE model, they are only facilitating us to define our own process for course design.

The model tells you what the elements of that process should be. The process design and the way you want to handle the content are completely your choice. In the last module, we understood the process of designing and managing item banks for quizzes, assignments, tests, and semester end examination for an engineering course. We have been repeatedly saying assessment is really the key. If I have a very poor assessment, automatically it communicates that I am expecting only poor learning from the students.

If your assessment is not designed right, the students are unlikely to learn anything well as required by potential employers. Assessment is not something very easy to design and manage. In the last unit, we looked at the role of item banks (though initially lot of work needs to be done by groups of faculties; but once it is done, and by managing the item bank properly it is possible to reduce the load on the faculty while maintaining good quality of assessment.)

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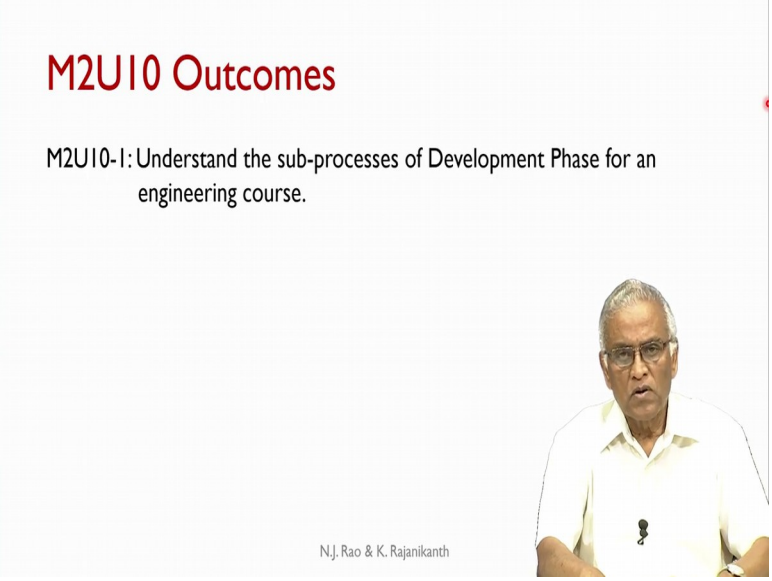

In the present unit, we move on to the development phase. Here we try to understand the sub-processes of development phase for an engineering course. If it is a non-engineering course some of the processes will be different. The sub-processes we are going to present are our suggestions. If one feels that they need to either slightly reword or modify them. You are most welcome to make suitable changes. But you must recognize the requirements of development phase.

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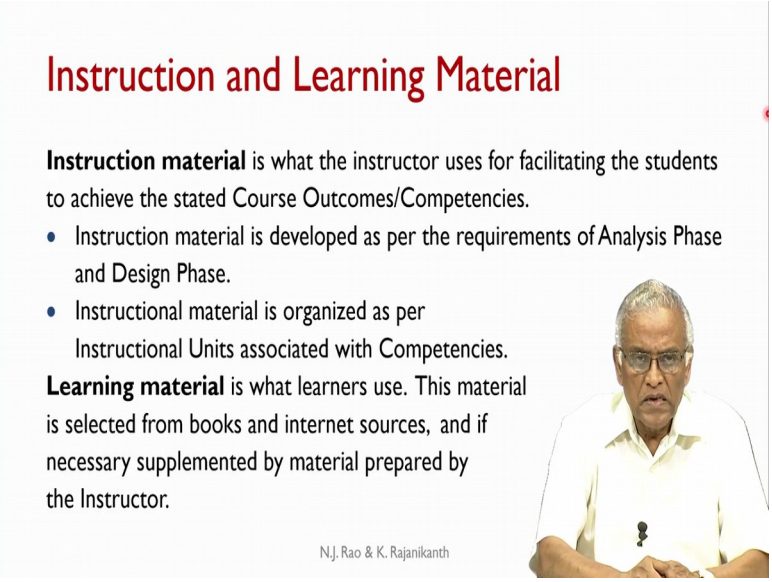

Primarily the development phase is concerned with developing instructional material and learning material of the course. What is instructional material? It is what the instructor uses for facilitating the students to achieve the stated course outcomes or competencies. Course outcomes are elaborated into a larger number of competencies.

On what basis do you develop? Instructional material is developed as per the requirements of the analyze phase and design phase. Analysis phase will identify the competencies and course outcomes, creates sample representative assessment items, and we locate the course outcomes and competencies in a taxonomy table. The, design phase majorly focuses on assessment. How do we organize this instructional material? It is as per the instructional units associated with competencies.

Consider that there are about 8-course outcomes in a course. Some of the course outcomes may take 7 hours or 8 hours. In such cases we elaborate the course outcomes with larger scope into a number of competencies. When you count the course from the competency perspective, you may have anywhere up to 10 to 15 If there are 15 competencies there will be 15 instructional units; that means, there is one instructional unit with respect to one competency. One competency will never take more than 5 classroom sessions. We look at about one competency that is likely to take maximum number of 5 classroom sessions and develop instructional material: How do I start

classroom activity, what do I do in the class, where do I ask questions and what kind of assignment do I give in the classroom and so on.

To conduct all these activities, we write the instruction material. Whereas, learning material is what the learners use by themselves; this material is normally selected from the books and internet sources. Generally right in the beginning when we give the syllabus to the students, we identify textbooks, reference books and these days we also refer to the internet sources. A good source also annotate the internet source; that means, what is that internet source is good for, or what elements it is focusing on. By annotating that you make it more convenient for the student.

Sometimes a teacher may want to do something more than what is available in a textbook or internet source. In such case, the teacher prepares some material and supplements the learning material available from the other sources. Broadly learning material either is chosen from a source and/or supplemented by material prepared by the instructor. We mainly look at the instruction material.

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Development phase: we propose the following activities or sub-processes: choosing the delivery technologies (we presently see that,) choosing the instruction type, development of instructional material, identification/selection/preparation of learning material and having all these outputs of development phase peer evaluated.

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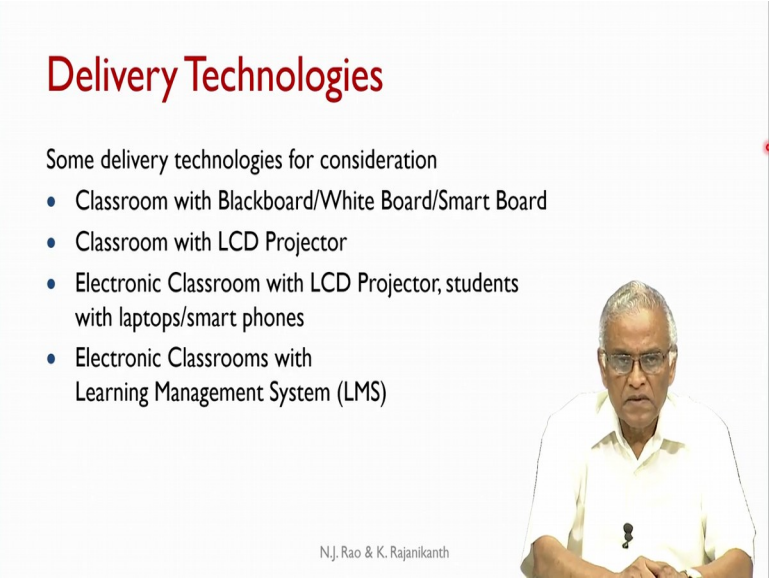

Let us look at delivery technologies. There may be many more combinations possible. Some of the delivery technologies are: classroom with blackboard or a white board or a smart board these days; classroom with LCD projector. You may have a blackboard or a white board along with an LCD projector.

As we go down, the earlier technologies are also available; that means, if I am having a classroom with LCD projector, normally you have access to the black board or a white board. Electronic classroom with LCD projector, students with laptops/smart phones; electronic classrooms with learning management system or you can have still more combinations where anything that you do you can record as a video and the students can have access subsequently for that. But these are the technologies that can be considered for ready implementation in many places.

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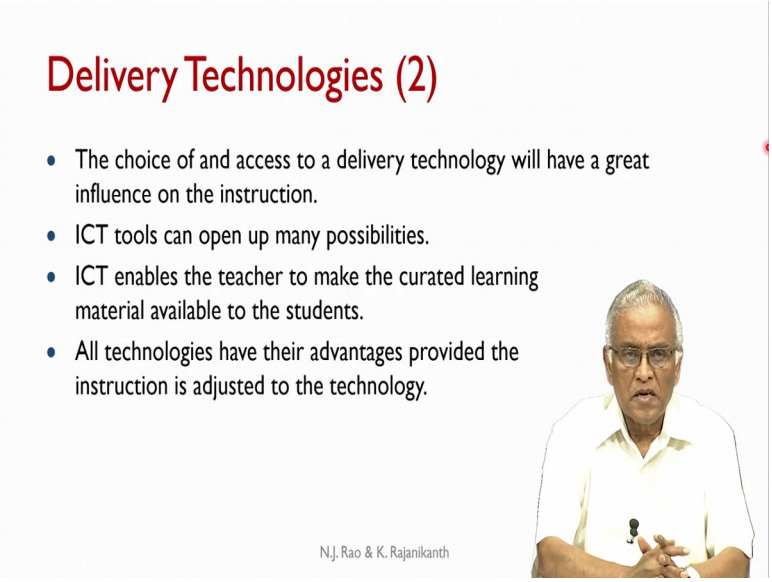

In terms of choosing the choice and access to a delivery technology will have a great influence on the instruction as well as the instructional material that you prepare. Fairly more than 80 percent of the faculty today are still using blackboard. Write on the blackboard while speaking, the teacher would have prepared that material for his own use with may be some additional comments written at different places.

Sometimes the teacher will innovate on the fly; that means, based on discussion with the student, they may want to slightly deviate from the material that they have already prepared and then take off from that point and explore. There are some teachers who will not take any notes and they are so familiar with the subject matter, depending on the situation they will keep moving they will take each time a different path.

I would consider that is only extremely small percentage of faculty who feel comfortable with that. One is the particular choice that you make of delivery technology will greatly influence the instruction. ICT tools that are now available open up many possibilities. Teacher has to explore and try to borrow from what is available on the net and see what kind of tools can be used with respective to their course. It enables the teacher to make the curetted learning material available to the students. That means the teacher can explore on the net, sometimes you have E books which are available at some price and they can take segments of the book also these days and integrate the material in the teacher's own way and make it available to the students.

The stamp of the teacher comes through that curation of the learning material. With respect to these technologies, while they have several advantages, but the instruction has to be adjusted to the technology; that means, the teacher will have to change his ways of his interactions with the students in the classroom depending on the technology that he/she is using. Otherwise the teacher will not get the kind of advantages that are provided by these technologies, that is what one has to remember with respect to delivery technologies.

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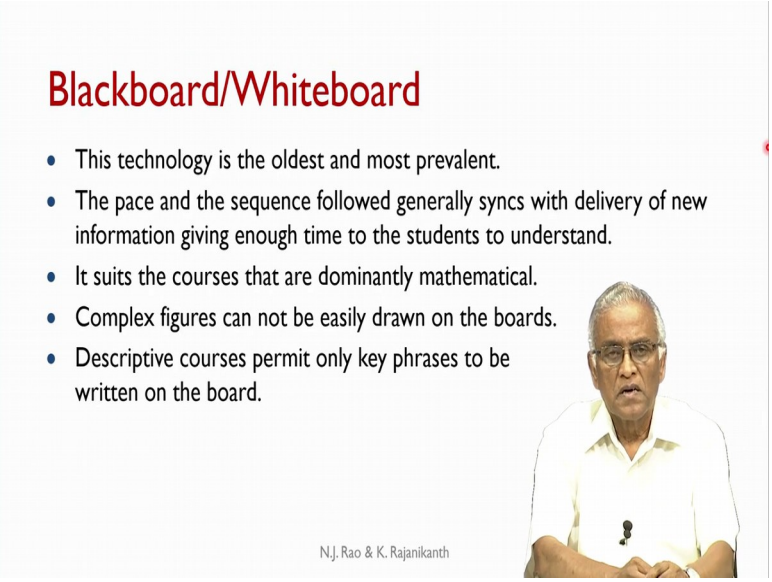

Let us look at each technology, blackboard or a white board or smart board. The technology is the oldest and most prevalent. The black board technology you can say goes more than 150-160 years may or many more years right into the 19th century or 18th century. The major advantage of this is, the pace and the sequence followed by the teacher generally syncs with the delivery of new information. While you are writing on the board the student has enough time to follow, understand and internalize. Also the common practice is whenever teacher writes on the board, the student also writes in his class notes. Though that material may be very similar to the text book material, but still they are listening at a particular pace and writing by their own hands what the teacher has written on the board.

There is certain synchronization that is possible and that is the greatest advantage. But then it has several other limitations as well. For example, to draw a complex figure (may

be some faculty members have good drawing skills, they may be able to do, but by and large) either it will take too much of time in the classroom or they may not be drawn satisfactorily.

In this process you several errors may creep in and those errors will stay with the student; that means, there is a possibility of miscommunication taking place when dealing with complex diagrams and some kind of cross sectional figures and so on. But the black board or a white board suits the courses that are dominantly mathematical; that means, when you have to write several complex equations on the board, there is no other method that is as comfortable as this. When it comes to descriptive courses, the blackboard method is not particularly great.

The only thing that can be done in descriptive courses is, teacher can write some key phrases on the board, then the student has to start filling in the details. The problem is while student is writing his/her own observations, they may go out of sync with what is being presented by the teacher.

Therefore the blackboard is certainly convenient for mathematics courses, it has the advantage, we have been using it for very long time, nobody will have objection to that, but there are several limitations to this especially with regard to engineering courses where complex timing diagrams, complex block diagrams have to be drawn.

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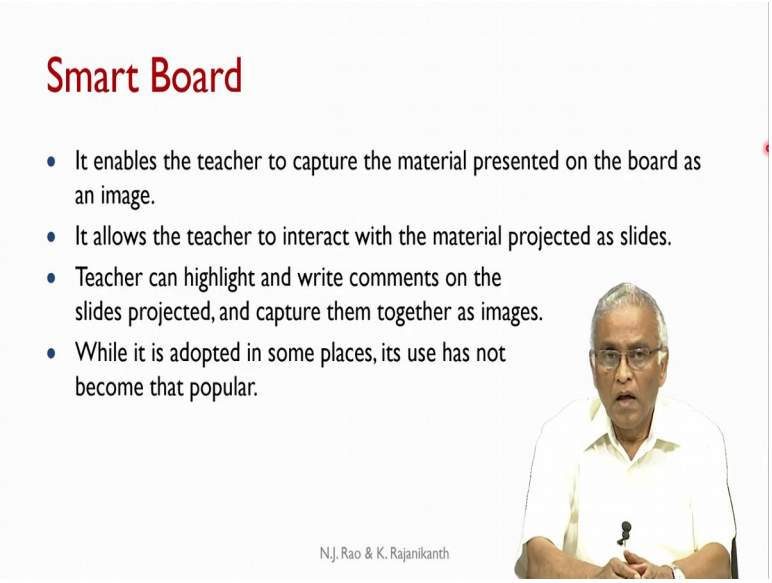

Smart board other variation: it enables the teacher to capture the material presented in the board as an image. Whatever you write on the board, it can be captured as an image and made available to the students through emails or WhatsApp these days.

When the material is projected as slides on to a white board - while speaking it allows the teacher to interact with that material by either highlighting or adding an extra comment, adding a small diagram, underlining something and so on. The entire slides and the over written comments can be captured in an image and made available to the students. The student has access to the way it has been conducted in the classroom.

When the smart boards came, there was lot of hype around that; many people bought that while it is adopted in some places its use has not really become that popular.

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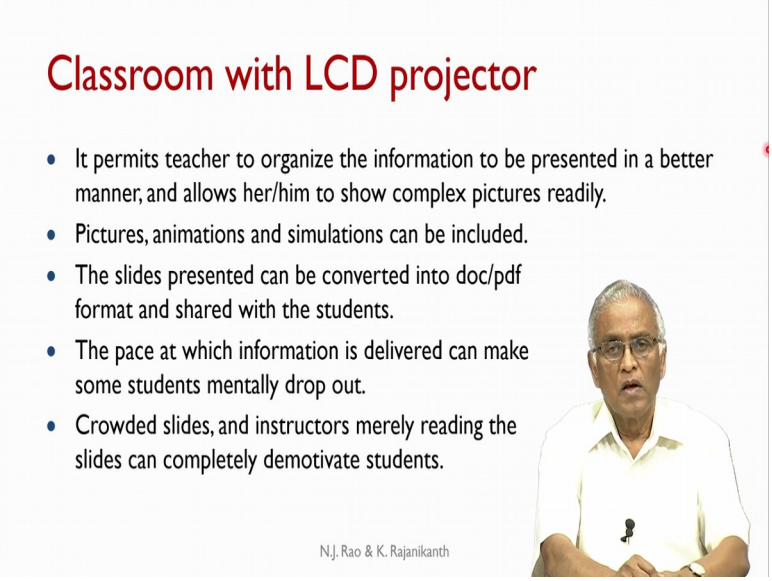

Classroom with LCD projector: we assume there is also a blackboard or a whiteboard the teacher can make use of it. First it permits the teacher to organize information to be presented in a better manner and allows her to show complex pictures readily- that is one significant advantage of LCD projector.

Earlier, there were overhead projectors. Preparing slides was a very complex and expensive process, and then if any change has to be done in the slide, the slide has to be thrown out, and new slide has to be prepared, but that era has gone. With LCD projector

if you want to make any change electronically; you can make the change in the slides. The significant advantage is you can present complex information in varieties of ways.

On top of that, any kind of still pictures, animations, simulations can all be included in the presentation. Usually, when you are projecting on the slide, you are projecting the material using your laptop or a PC. As you have access to the laptops simulations can be done in a dynamic manner. That means I can change the parameters and simulate and show what happens in the system.

The slides can be presented directly or converted into a doc or a pdf format and shared with the students. This is where the limitations come. The pace at which information is delivered can make the students mentally drop out; for some reason you are likely to be a little faster than the student can capture.

If the student is not able to keep pace with what is being presented, and he will mentally drop out. You can say that also happens with a whiteboard, but when the information is already curated and projected there is a tendency on the part of teacher to go through this material much faster than usually he or she does otherwise. This issue can be readily overcome through a little bit of practice to deliver at a pace that you think the students are following.

Another issue is many people have tendency to crowd the slides, i.e., write lot of materials into one slide. The instructor may look at the screen and just keep reading the material, not even face the students; which is the best way to de-motivate the students.

While technology has several advantages, with some difficulty one can adopt to even presenting mathematical subjects. It is possible to create some kind of animations into the slides so that the material is presented in an interesting sequence and slow enough for the student to keep track.

But over-written slides can certainly de-motivate the students. It does happen whenever you go to a seminar or a presentation where the slides are crowded. It becomes challenging to keep track of material.

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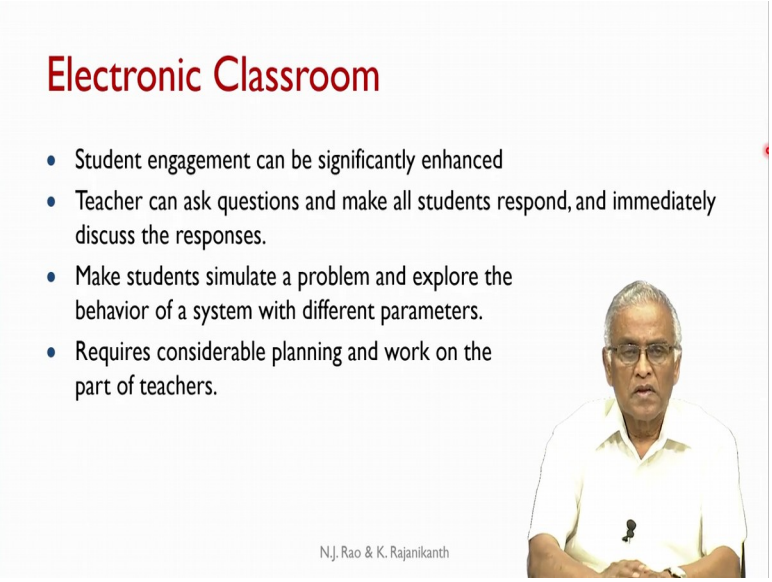

One notch above is the electronic classroom. Electronic classroom can significantly enhance the engagement of the students with the material. What is an electronic classroom? It will have an LCD projector, a connection to the internet through either Wi-Fi, the teacher uses a laptop of his own and the students also have access to either laptops or smart phones/Tablets.

One major thing that comes that cannot happen in the blackboard approach is teacher can ask a question and make all students respond to that; organize the responses of the students and if there is any odd responses (some people obviously do not understand the issue) the teacher can pinpoint and discuss the response as to why it is so. Questions can be asked and all students can be made to respond which cannot happen in a normal classroom because only 2 or 3 will respond.

You can make students simulate a problem and explore the behavior of the system with different parameters. With respect to many engineering courses in all branches where you want to simulate the behavior of a slightly complex system and keep looking at what happens when a parameter is changed and how the output changes. That is one of the best ways to learn the behavior of any dynamic system.

All these will require considerable planning and work on the part on the teachers as well as to make sure there are no technology glitches that happen while you are conducting the class. If something does not respond; if there is no internet connection, suddenly it

breaks down or you have some problem with your laptop connection to the projector, any of those technology glitches can destroy the effectiveness of the electronic classroom. To overcome this issue, the teacher should make sure that if he is using an electronic classroom that everything is in working condition before you start the class.

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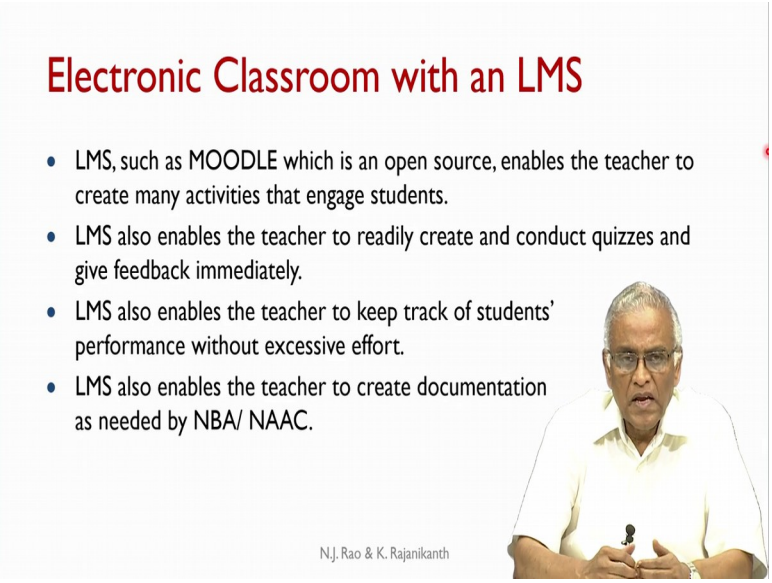

To the electronic classroom, add a learning management system. Even an academic management system can be added. For example, for LMS you have the well known MOODLE which is an open source software. Many people have started using the MOODLE and use it for various purposes. Essentially MOODLE allows the teacher to create many activities that engage students without losing too much of time, but it requires; obviously, a lot of planning. For example, you can conduct a quiz, the quiz itself can be organized and conducted using LMS and the responses can be collected quickly.

After conducting a quiz, you can give feedback immediately, that is a wonderful mechanism of making everybody engaged with the knowledge. You can make all the students respond, and LMS will also readily identify if somebody is not responding.

Using LMS will greatly facilitate the teacher to conduct a quiz and give feedback. The very process of conducting a quiz will make all the students participate and get engaged with the knowledge. LMS will also enable the teachers to keep track of students' performance without excessive effort because all that information all the time is

available. Any time they can access information on what the student has done with respect to an assignment, what is the difficulty he has etc.. Everything can be quickly accessed once the faculty get used to how to make use of it. He can keep track of the students' performance.

Most importantly these days, LMS enables the teacher to create documentation (new procedures) as needed by NBA or NAAC. What teachers consider as a clerical activity of putting the material in all kinds of forms and calculating (all kinds of things,) is taking away lot of their time. All that time can be saved if a LMS or an AMS (Academic Management System.) is used.

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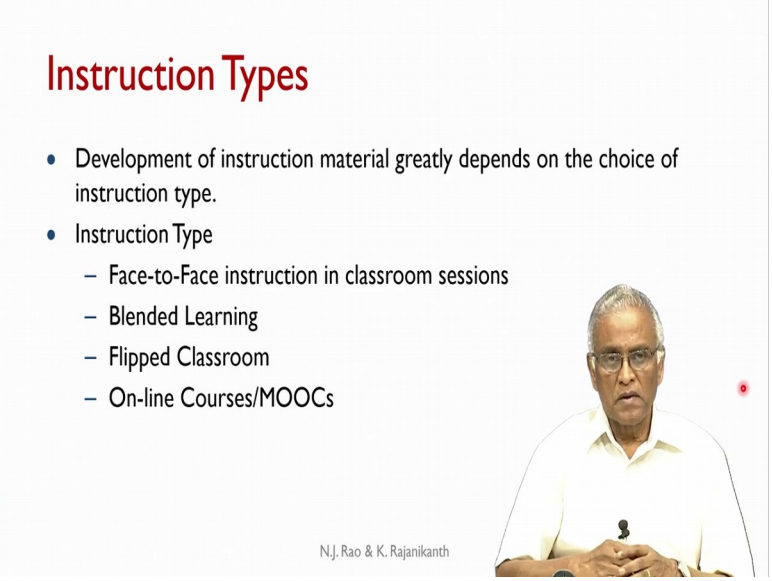

We looked at the various delivery technologies, and one should make the choice of the delivery technology and then only they can prepare their instruction material. When other technologies are used, simple notes, and material to be written on the blackboard cannot be used.

Instruction types: The development of instruction material will also depend on the choice of the instruction type. What is instruction type? Let us give the four popular examples of that; (1) face-to-face instruction in the classroom- that is what all people are familiar with. That means, you go physically into a classroom which has certain facilities and the students and teachers are face-to-face. (2) blended learning (3) flipped classroom and (4)

online course. The next version of that online course is a MOOC, a type of instruction that we are right now you getting involved.

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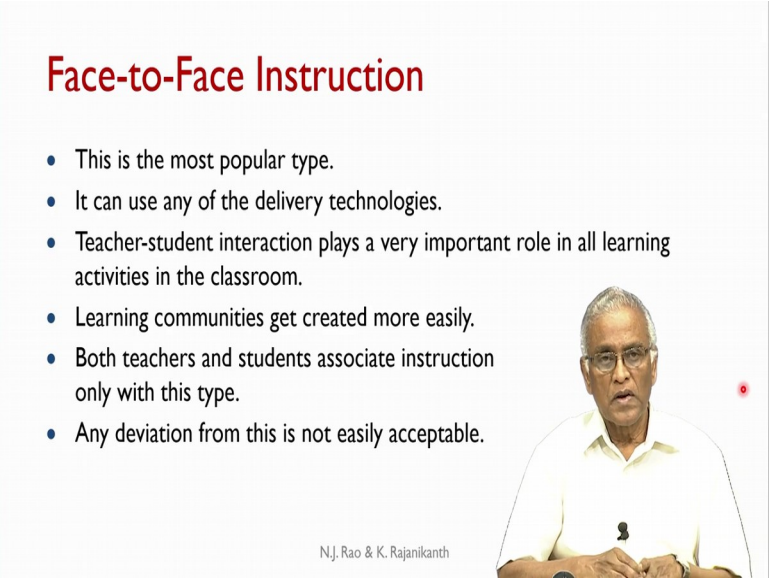

Face-to-face instruction is the most popular type; it can use any of the delivery technologies. Teacher-student interaction plays a very important role in all learning activities in the classroom. It can play both positive and negative roles (it depends on teacher's ability to interact with the students.) In the classroom, students are gathering, and they are interacting with each other before getting into the classroom, and after the classroom, the learning communities can get created naturally and more efficiently.

Groups will form and start discussing what has happened in the class, what were their experiences, they will ask each other questions, and generally groups of 4 -6 seem to be readily forming which is a very healthy thing. Both teachers and students associate instruction only with this type even now. If it is not face-to-face, both the students and teachers may feel somehow suddenly out of place something is not right.

Any deviation from this is not easily acceptable. If you want to use any other types of instruction, there is a specific barrier that you have to cross, and you can cross that barrier only if you are able to really show distinct advantages over the face-to-face instruction and that is where it requires lot of preparatory work.

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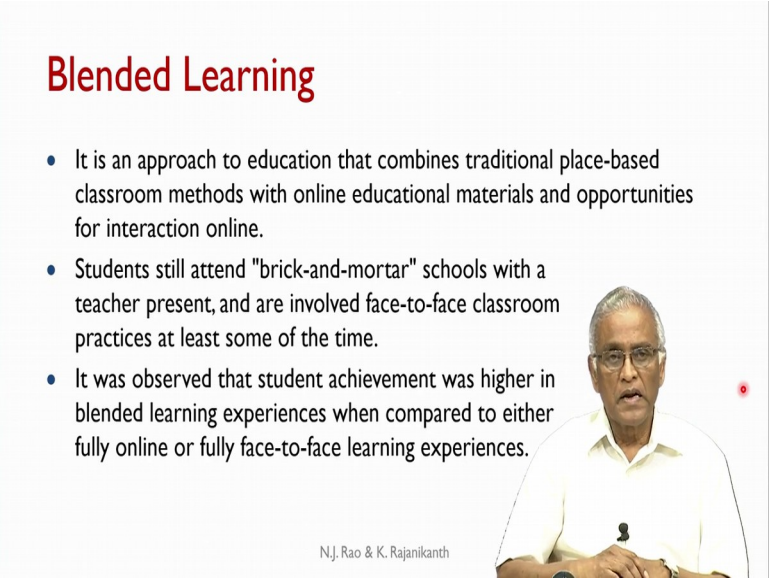

Blended learning combines the traditional place-based classroom with lot of online materials and opportunities for interaction online. That means face-to-face where students go to a classroom, and a teacher comes there with lot of online materials and opportunities for interaction online. Because you are using brick and mortar schools where you are going to classroom, the students and teachers still feel comfortable with something that they are used to.

But blended learning reduces the number of hours that you spend interacting inside the classroom. The face-to-face sessions are somewhat reduced. For example, if you have four lecture hours per week, initially I may reduce the number of lecture hours to 2. The students have to do their studies and homework online in the remaining two periods. Of course, this requires the students take the initiative, and they have to read the material before coming to the class. Sometimes the teacher may also explain some different concepts in the classroom, but a lot of work will have to be done online. It has been found that the performance of the students greatly improved compared to full-time online or fulltime face-to-face learning.

That means fully online has some limitations (as we will see) and fully face-to-face learning experiences have their own limitations. Instruction by blended learning has been established through a lot of field research, and the students seem to be learning better through that.

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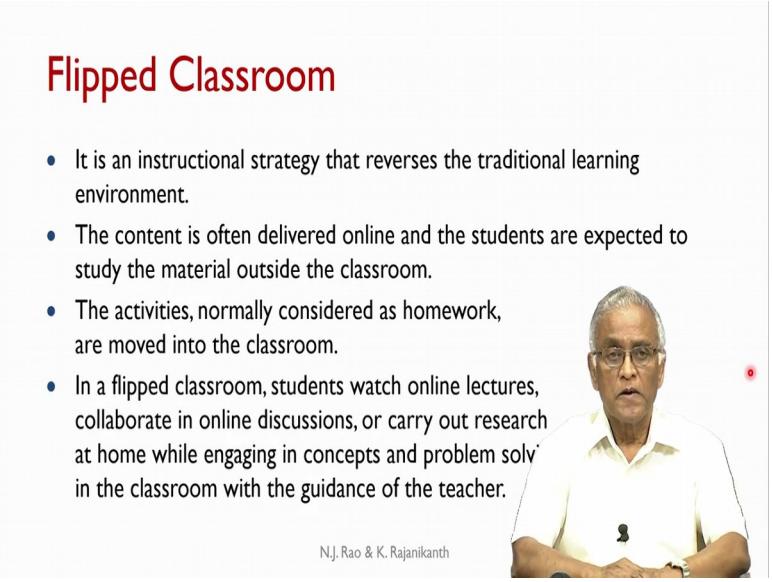

A flipped classroom is a modified version of blended learning; that means you essentially flip. What you usually do in the classroom of explaining something in the classroom and ask the students to do some assignments outside the classroom is interchanged. The content these days can readily be delivered online, and all students have access to learning material through their internet devices, and they are expected to study the material outside the classroom. They can look at videos, they can read the material, or they can look at the slides prepared by the teacher.

What customarily considered as the homework is moved into the classroom; that means, the classroom is exclusively used for discussions and possibly solving some problems. That is flipped classroom, and once again, its effectiveness will depend on the teacher doing lot of planning and also the students willing to participate.

It has been found that some students because they are used to right from childhood to a face-to-face kind of instruction, any deviation from that is not readily acceptable. Therefore students may complain in spite of all the advantages of this.

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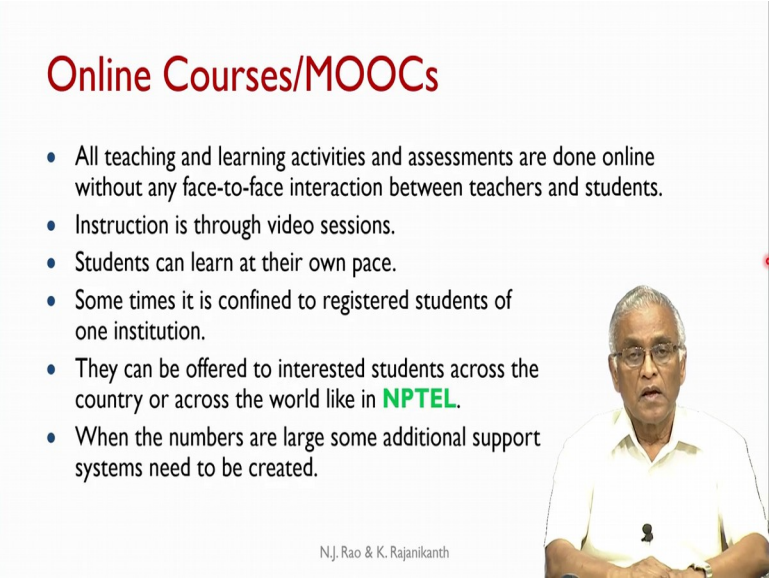

Online courses: all teaching and learning activities and assessments are done online without any face-to-face interaction between teachers and students. There is no direct interaction. Interaction is through video sessions like what we are doing right now. Students can learn at their own pace that; means, they can look at a particular video as many times as they want or at their own place or at their one pace.

In many universities when they offer online courses, the courses are confined to the registered students of one institution whereas, the course that we are offering under the NPTEL anybody anywhere in the world or in the country can get access to the course. The only issue is when the number starts becoming large, it is required to create some kind of additional support by way of teaching assistants. If there are some questions students are rising, and if there are many, then it will be difficult for the faculty members to interact with large numbers. In that case you have to create necessary teaching assistant support which NPTEL does.

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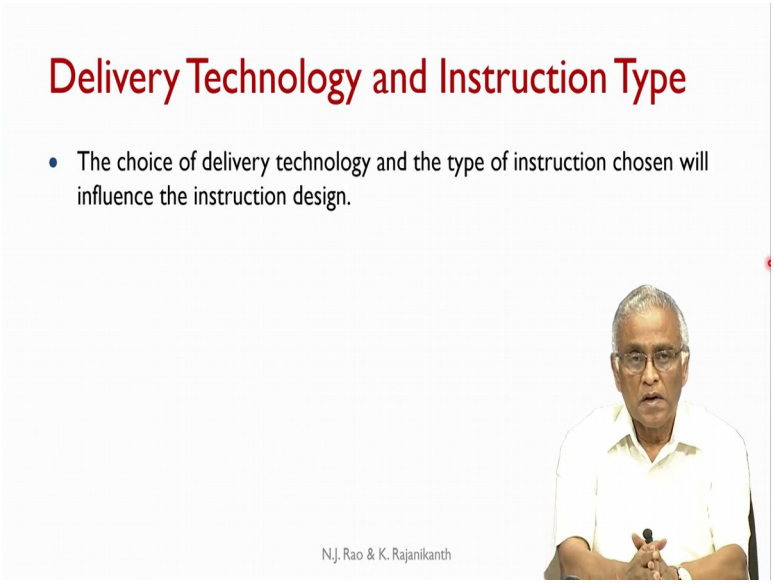

To summarize the choice of delivery technology and type of instruction chosen will influence the instruction design, which will be the topic for the next unit.

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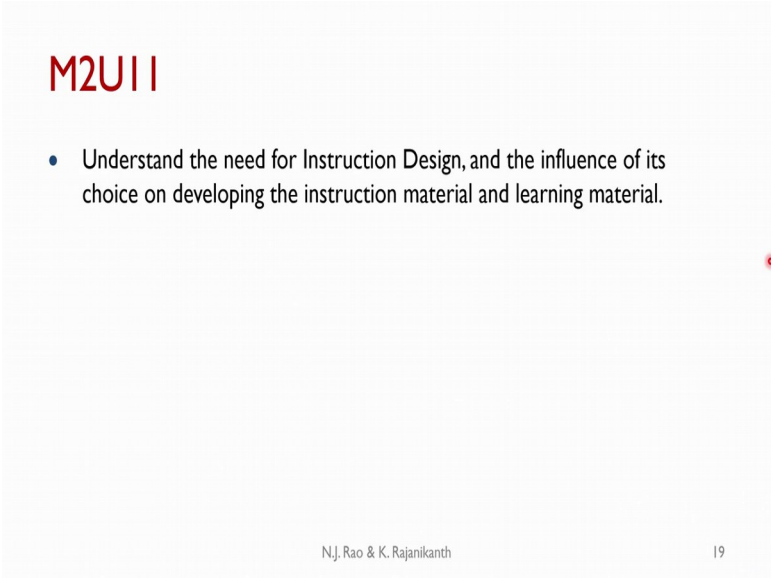

In the next unit, we will try to understand the need for instructional design and the influence of its choice on developing the instruction material and learning material.

Thank you very much.