TALE - 2 Course Design and Instruction of Engineering Courses

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Lecture – 28
Direct Approach to Instruction

Greetings, welcome to Module 3 Unit-10 on Direct Instruction.

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In the earlier unit, we understood instruction design based on Merrill's principles. Earlier to that we looked at Merrill's general first principles of learning. Based on that, we looked at one instruction design. Also, we saw that the instructional design which implements all the five Merrill's principles is not unique.

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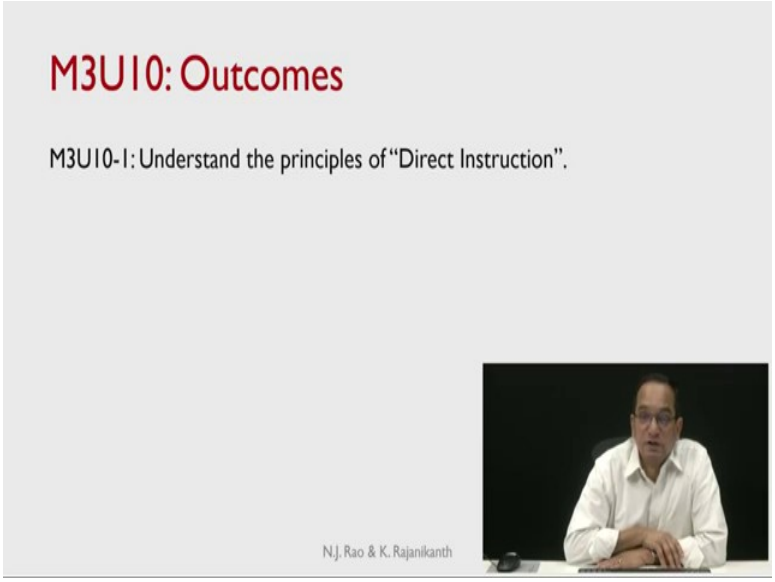

From this unit, for the next 3 - 4 units, we look at some of the popular models for instruction which have been available in the literature. Considerable body of research exists regarding these approaches. We also have considerable amount of empirical evidence regarding the efficiency as well as the effectiveness of these instructions. We also have some information regarding how engaging these instructional methods are. Some of you might be familiar with some of these methods. But, because of the considerable body of research which has gone into these methods, we are now able to look at these methods in a very structured and systematic fashion.

In case you design your own instructional approach, this can serve as a kind of reference against which you can cross check and see whether the required components are all present in your instructional approach. First of this series would be the direct instruction. In this unit we will understand the principles of direct instruction.

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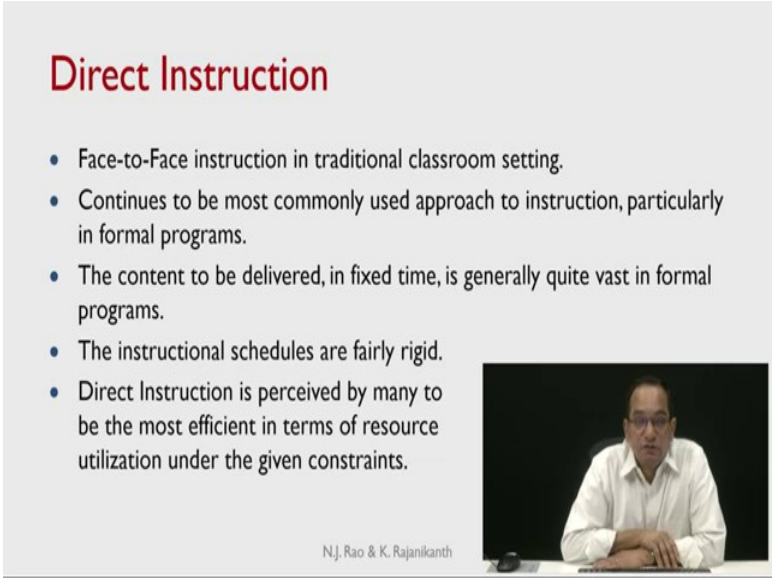

This is essentially face-to-face instruction in traditional classroom setting; in that, say, probably most of us are quite familiar with it. But probably we have to look at it in a more systematic fashion to see what are all the components of this well known method of direct instruction. This is basically face-to-face instruction in the traditional classroom setting and this continues to be most commonly used approach to instruction particularly in formal programs. In formal programs, the content to be delivered in a fixed time is generally quite vast.

The syllabus generally is quite extensive and the instruction schedules are fairly rigid. The tests, the quizzes, other components of internal assessment and finally the semester end the examination, when all these need to be conducted is fairly rigid. So, the amount of time available to implement any particular method has severe restrictions. In that context, direct instruction continues to be the most commonly used approach, because it is quite efficient in terms of resource utilization under these given constraints.

It can be effective also, but probably there are some difficulties in making this approach very engaging. But it is not impossible. But it needs certain specific effort. Primarily, the priority wise if we see, efficiency is valued over effectiveness as well as engaging nature of the instruction. The primary motivation for this approach is efficiency.

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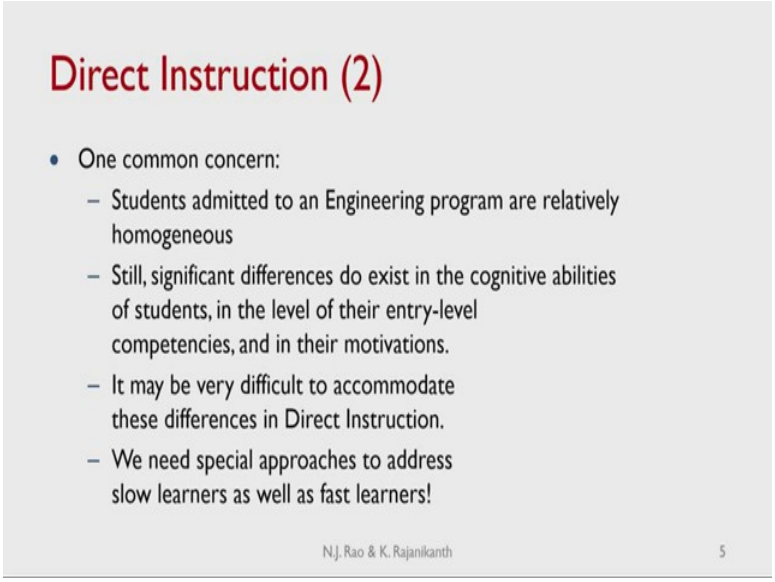

Of course, one common concern with this approach, with all their variations also, is that students admitted to an engineering program are relatively homogeneous. Still significant differences do exist in the cognitive abilities of students, in the level of their entry-level competencies, and also in their motivations. It may be very difficult to accommodate these differences in direct instruction.

However, we cannot ignore the fact that the students have considerable differences in their cognitive abilities and prerequisite knowledge and motivations. We need special approaches to address slow learners as well as fast learners and probably those with low motivation levels and those with high motivation levels. But that would be an approach which would be a separate aspect when direct instruction is used. Direct instruction by itself is not very good at accommodating these differences in the learners.

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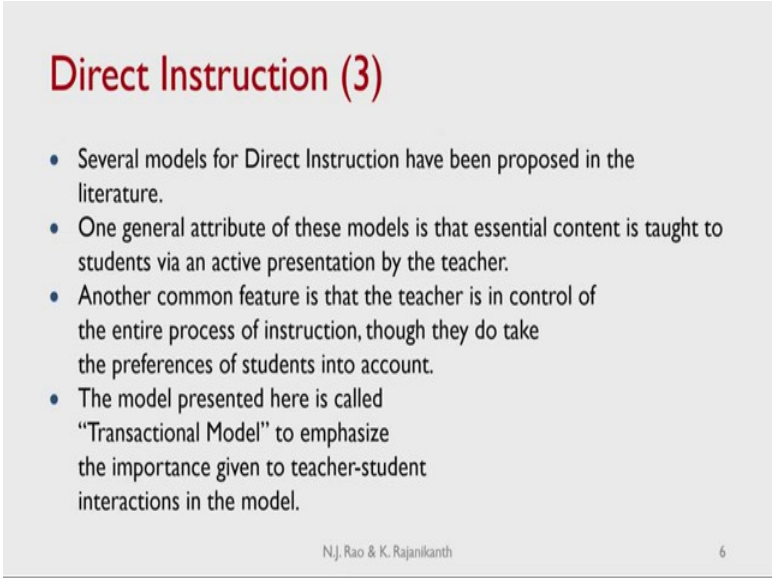

Several models for direct instruction have been proposed in the literature. One general attribute of all these models is that essential content is taught to students via an active presentation by the teacher. Another common feature is that teacher is in control of the entire process of instruction, though teachers do take the preference of students in to account. Even though they do take the preference of students in to account, teachers are in control of the whole process; so direct instruction is basically a teacher driven process. The model presented here is called transactional model to emphasize the importance given to teacher-student interactions in the model.

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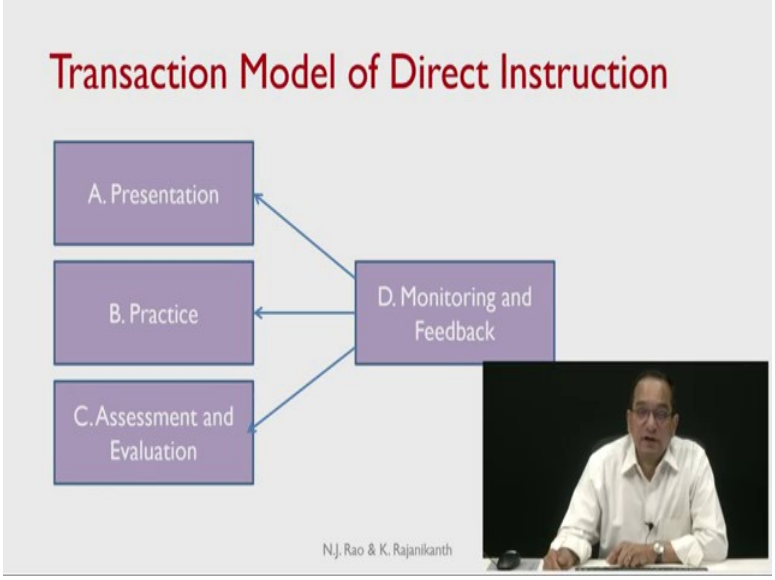

As per the model shown - primarily there are three phases: a presentation phase, a practice phase, assessment and evaluation phase. Then there is also a component of monitoring and feedback, which actually works throughout all these three phases. As and when necessary, the monitoring and feedback aspect comes into the picture. So, in the figure, you can see that there are arrows from monitoring and feedback to all the three phases of presentation - practice, assessment and evaluation.

Quite informally presentation is by the instructor, assessment and the evaluation is by the instructor, practice is primarily by the learners and monitoring and feedback is by the instructor. It is primarily an instructor driven model or teacher driven model with students' active interaction with the teacher.

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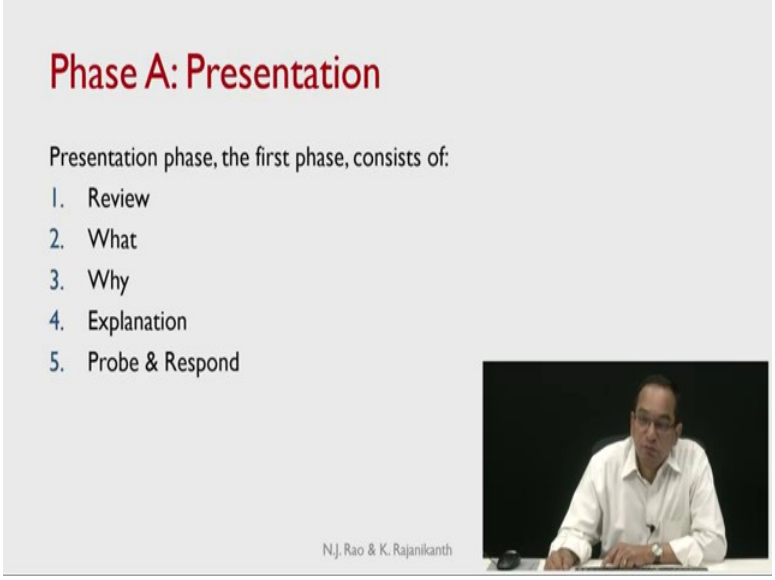

The first phase - presentation phase - has these following five activities: review, what, why, explanation and probe & respond. Let us look at these five instructional activities in some detail.

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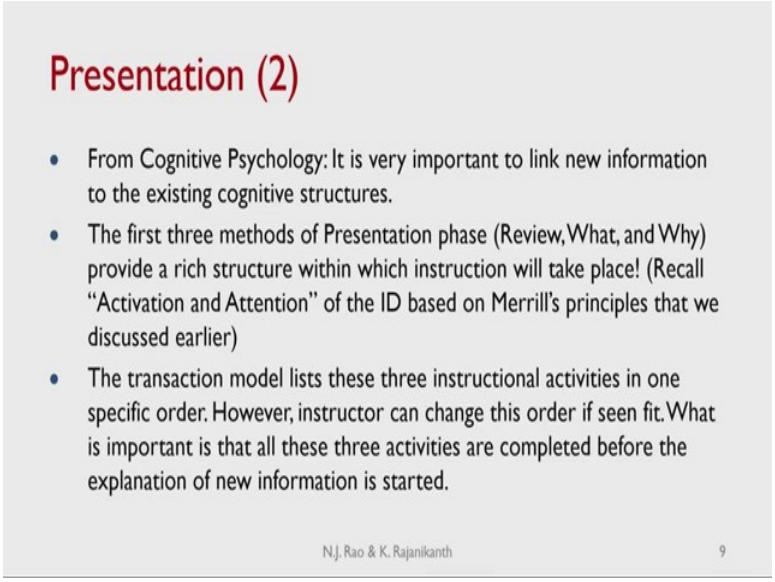

From the cognitive psychology, it is well known that is very important to link new information to the existing cognitive structures. This is also the attention principal of Merrill. The first three methods of presentation phase - review, what and why - provide a rich structure within which instruction will take place. So, primarily this corresponds to the activation and attention of the ID based on Merrill's principles that we have discussed in the last unit.

The transaction model lists these three instructional activities in one specific order, review, what and why. However, instructor can change this order if seen fit. What is important is that all these three activities are completed before the explanation of new information is started. Before the instructor moves onto the new knowledge, it is essential that all these three activities are completed (review, what and why).

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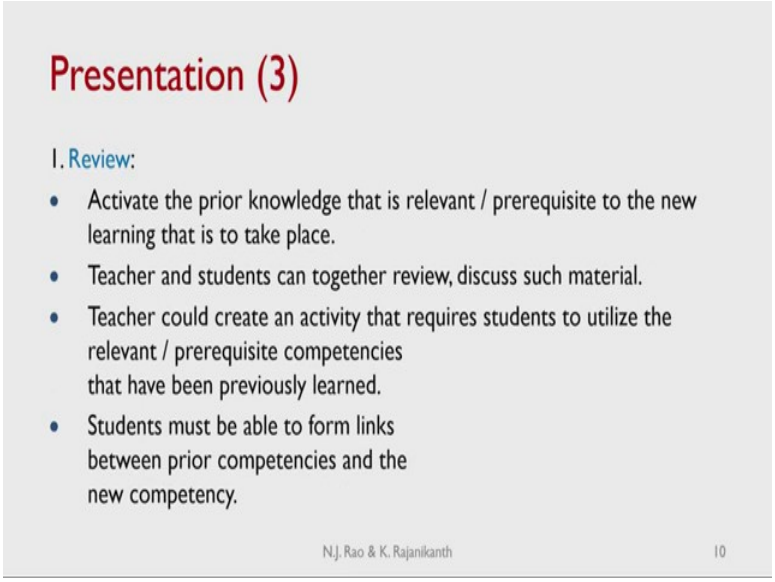

Review: Activate the prior knowledge that is relevant prerequisite to the new learning that is to take place. There are several instructional components which the teacher can use for this purpose; teacher and student can together review, discuss such material.

Teacher could create an activity that requires students to utilize the relevant prerequisite competencies that have been previously learned. This activity could be solving a problem or a small quiz or discussion of a particular approach to a specific problem. It could be group discussion. Several instructional components can be picked up to ensure that the relevant prerequisite competencies are invoked. Students must be able to form links between prior competencies and the new competency. So, this is the first activity that we should do.

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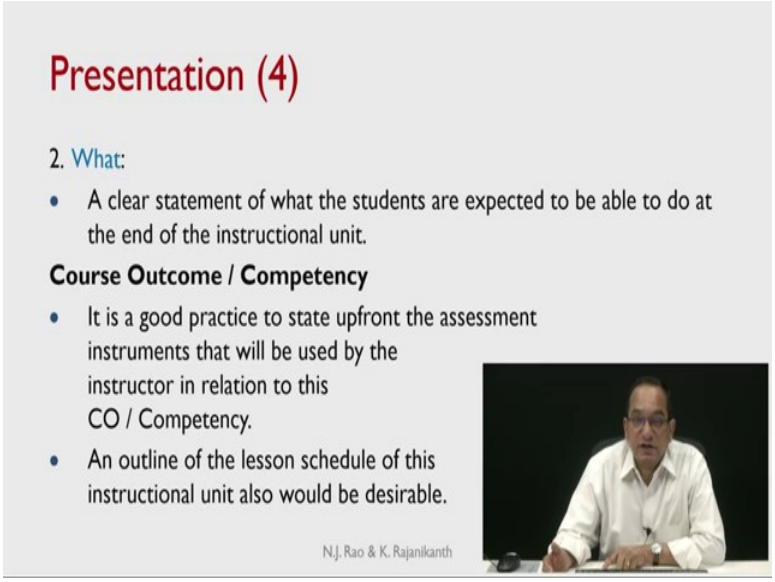

"What" is a clear statement of what the students are expected to be able to do at the end of the instructional unit which is for us is the course outcome or competency. It is a good practice to state upfront the assessment instruments that will be used by the instructor in relation to this CO/competency. This is also considered as very important. Students must know what would be the criteria on which they are going to be assessed and evaluated. It is a good practice to state, up front, the assessment instruments that will be used by the instructor which will provide a proper direction to the learning by the students.

Corresponding to one particular given competency/course outcome, there may be multiple instruction sessions. If it is so, it would be also helpful to provide a schedule of these lessons, what would be the topics for discussion in each of these lessons and how the sequencing of the content would proceed. It would be helpful if an outline of this lesson schedule of this instructional unit is also presented upfront. In the 'what' phase we provide a clear statement of the learning outcome - the course outcome or the competency. We state what will be the assessment tools to be used. We also provide an outline of the lessons schedule or what you may call as instruction schedule.

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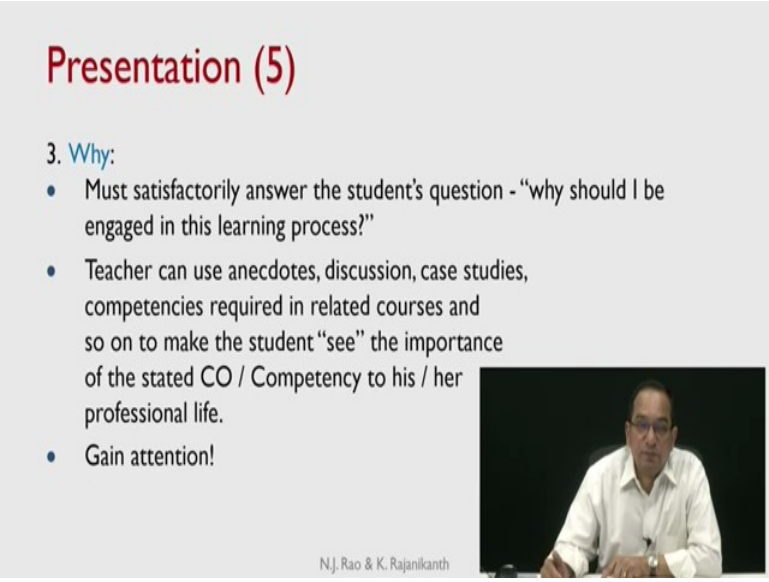

The next important point is 'why.' Instructor must satisfactorily answer the students' question, 'why should I be engaged in this learning process?'; 'what is in it for me, how is it relevant to my profession, where I am going to use this knowledge, what kind of problem solving skills do I get from this particular learning activity?'. These kinds of questions would be really at the back of the mind of the learners and unless the instructor is able to satisfactorily answer these queries of the students, learning is likely to suffer.

Teacher can use a variety of anecdotes, discussions, case studies, competencies required in related courses and so on to make the students see the importance of the stated CO/competency to his or her professional life. This is essentially the "gain attention" that we discussed in the earlier unit. This is very important to ensure that the instructor is able to engage the students in meaningful learning.

A wide choice of the instructional components exists at this level. The instructor can pick up appropriate instances, appropriate uses based on the situational factors. But, it is very important that the students concern as to "why I should be engaged in this learning process" is satisfactorily answered.

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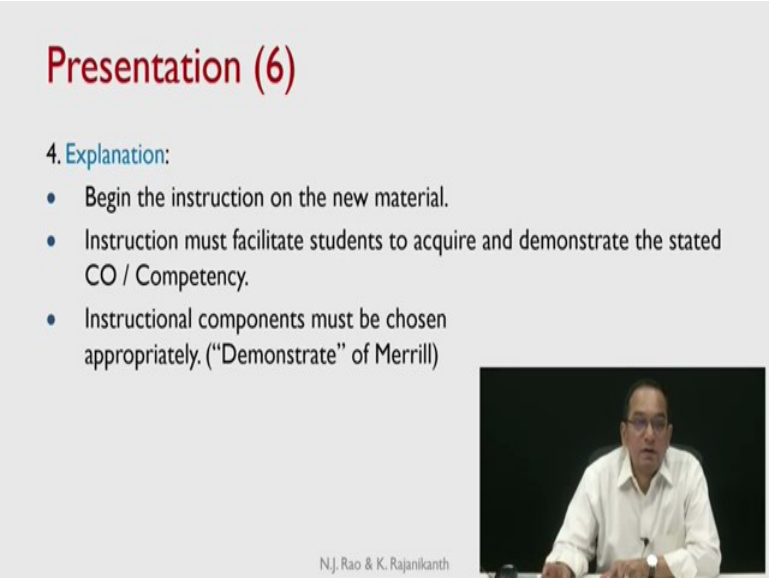

Then begins the actual instruction on the new material. So, the instructional activities 1, 2, 3 form a kind of preamble to the actual instruction. 4 is explanation where the instruction on the new material commences. We already know that instruction must facilitate students to acquire the competencies stated and demonstrate those competencies. Whatever instructional components are best suited for the given CO/competency are picked up by the instructor.

This is totally a choice of the instructor; given the specific course outcome/competency, which instructional components would be the most effective based on the taxonomy levels of the COs or competencies; based on the cognitive process level, knowledge category. Suitable instructional components can be picked up by the instructor. So this part of it is a totally instructor decision. Instructional components must be chosen appropriately basically. This corresponds to the "demonstrate" of Merrill.

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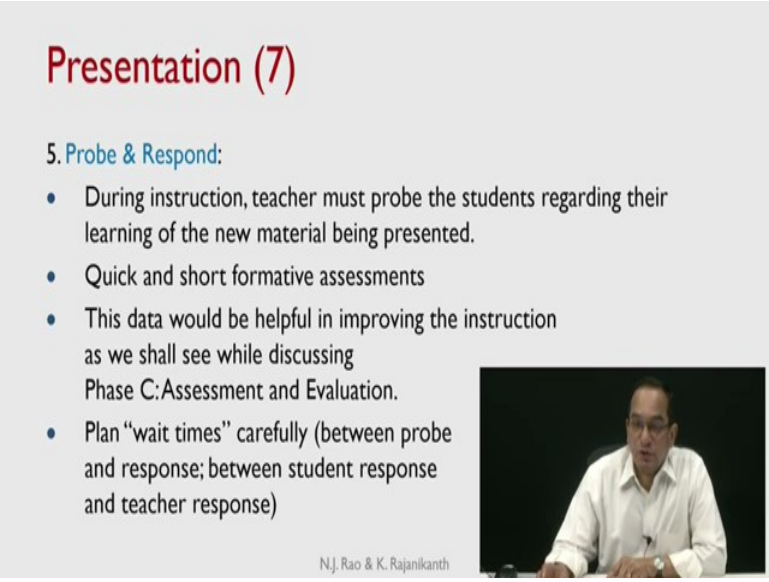

"Probe and respond" is a very key activity to ensure that learning is happening in a proper fashion. During instruction, teacher must probe the students regarding their learning of the new material that is being presented by the instructor. The purpose of this probing is to check whether the understanding of the students is proceeding in the proper directions; whether the concepts are being understood in the proper sense; whether the procedural steps are being understood in the proper sense.

Basically it is a very quick and short formative assessment. The results of this probe, probing questions, would help the instructor to fine tune the instruction where necessary. This data would be helpful in improving the instruction and we will discuss this further, when we look at the Phase C which is assessment and evaluation.

During this probing, it is also important to plan wait times carefully. There are two kinds of wait times. One is between the probe by the instructor and a response by the students. How much wait time do I allow there? Another wait time is between the students' response and the teacher's response. Here also we must plan carefully; too much wait time would make probably the class a little bit restless and probably attention will be lost; and if the wait time is too small, it is probable that the students feel somewhat frustrated that they are not getting enough time to respond to the query of the teacher.

These wait times must be planned carefully. Many situational factors influence these - the kind of learners/homogeneity that we have; the specific course that is being taught;

the classroom context - all these would come into the picture. There is no recipe which tells us what should be the wait time. It is basically the instructor who has to decide on this depending upon how actually the instruction is taking place.

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Then the Phase B is concerned with 'practice.' It is widely established that providing learners with a very large number of opportunities to practice the competencies being acquired is crucial element of quality learning. The student acquires the new knowledge and if the student is able to apply that knowledge to solve a problem as quickly as possible, the learning becomes deeper.

This is a well established principle of learning that the students must apply their knowledge in order to really get a deep understanding. Practice phase of direct instruction model has three aspects - guided practice, independent practice and periodic review.

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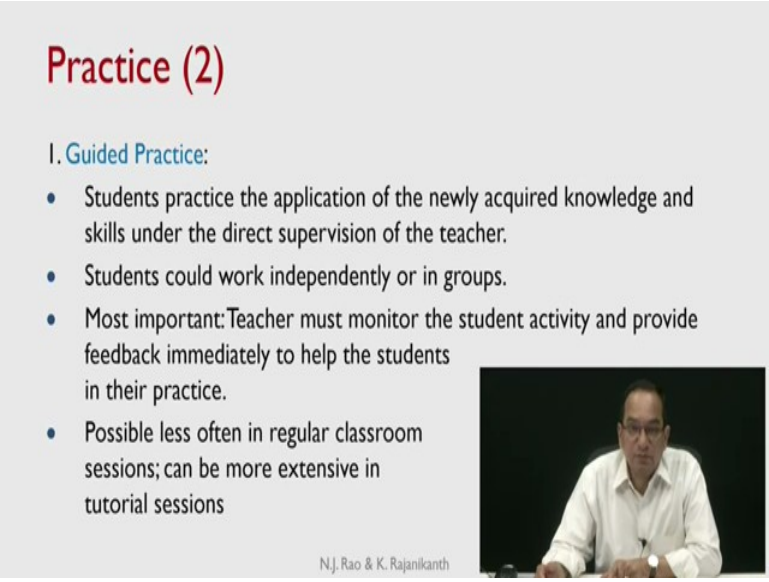

The guided practice, as the name implies, essentially means that students practice the application of newly acquired knowledge and skills under the direct supervision of the teacher. Students could work either independently or in small groups, but teacher must monitor the student activity and provide feedback immediately to help the students in their practice; which means that in a traditional classroom setting where the classroom size is fairly large, (it is not unusual to have a class of 60, 70 students), for one instructor, to closely monitor the student activity and provide useful feedback may be very difficult.

This part of it must be run in some kind of a tutorial mode, where there are only about 20 to 25 students with the care of one particular instructor or one tutor. In that case, it becomes possible to closely monitor the student activity and provide feedback immediately; the actual implementation again has to be worked out by the department. This is basically a kind of a tutorial mode; this can be quite extensive and effective in tutorial sessions. But this is guided practice, the problems to be solved are selected by the teacher; teacher is in control; and under the direct supervision of the instructor, students are practicing. Initially this would be the more adopted (practice).

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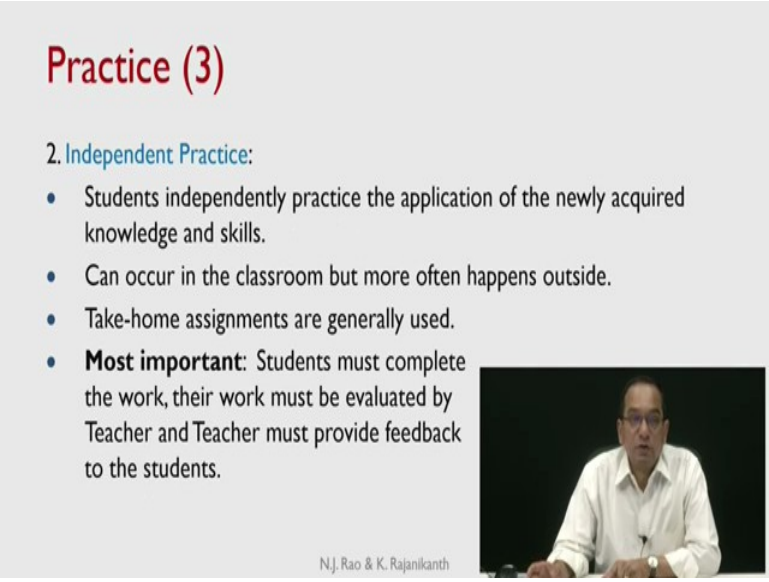

As students become more comfortable with the newly acquired knowledge and as they become more competent in terms of solving problems using this newly acquired knowledge, the mentoring by the instructor can be gradually reduced. The learners would move more towards independent practice. The students would independently try the application of the newly acquired knowledge and skills.

Again doing this in a classroom context may be very difficult given the time factors. Most often, it happens outside in the form of take home assignments. But, quick and short exercises could be carried out within the classroom context also. It essentially depends upon the nature of the course, the nature of the COs and the nature of the competencies that we are dealing with. Instructor has to make a choice regarding this. But the idea is that the teacher's supervision is withdrawn and students independently practice the application of the newly acquired knowledge to solve problems.

Most important aspect of the independent practice is that students must complete the work. Any assignment given must be completed by the students and submitted in time; and equally important, it must be evaluated by the teacher very carefully. In fact, a complaint that we often hear from students is that the assignments are more in the nature of a routine activity and these assignments submitted by the students are not really evaluated carefully by the instructors.

For the independent practice to be really effective, it is essential that the teacher evaluates all these assignments carefully. Or any other form of activity given; the independent practice by the students must be evaluated carefully and teacher must provide feedback to the students. Telling them what is right, what is wrong; if something is right, how it is right and if something is wrong, why it is wrong. This kind of a constructive feedback must be given to the students, if the independent practice is to contribute to learning.

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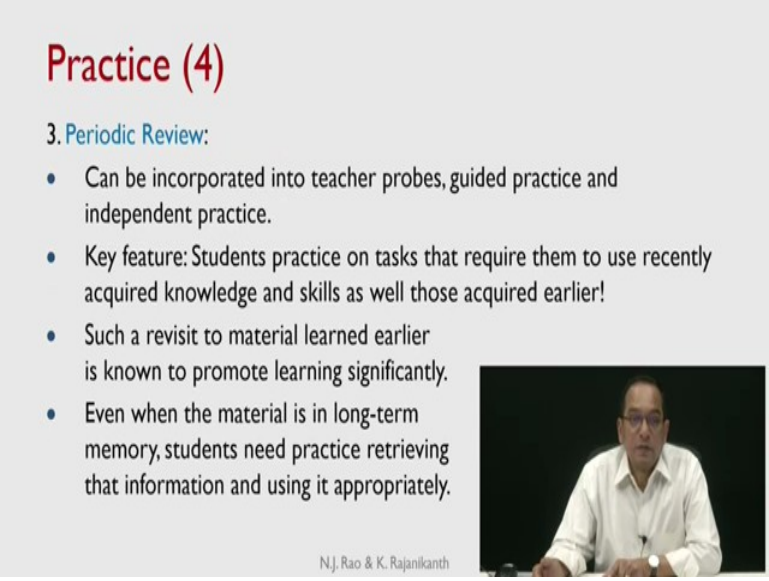

Periodic review: it can be incorporated into teacher probes, guided practice and independent practice. The key feature is that the students practice on tasks that require them to use a recently acquired knowledge and skills as well as those acquired earlier. This is a very important point that we should always try to ensure that the newly acquired knowledge and skills are integrated with the knowledge and skills acquired in earlier sessions.

The more often we try to have the students engage in this process of integration, the more likely that learning will be deep and the material learned would go into the long-term memory of the students. As often as possible, allow the students to combine the newly acquired knowledge with the earlier knowledge and use this combined knowledge and skills to solve problems. Basically, students practice on tasks that require them to use recently acquired knowledge and skills as well as those acquired earlier. This allows the

instructor to review the process of learning. Such a revisit to material learnt earlier is known to promote learning very significantly. The possibility that this material goes into the long-term memory of the student becomes very, very substantial, when this kind of a review takes place often.

Even when the material is in long-term memory already, students need practice retrieving that information and using it appropriately. Even if the learners have already committed this material to long term memory, it is worthwhile to help students practice recalling that information and using it appropriately. Thus the periodic review is an extremely important component. Of course, given the tight schedules, how much of periodic review one can do has to be decided by the instructor. But, to the extent that the constraints permit, instructor must ensure that periodic review happens.

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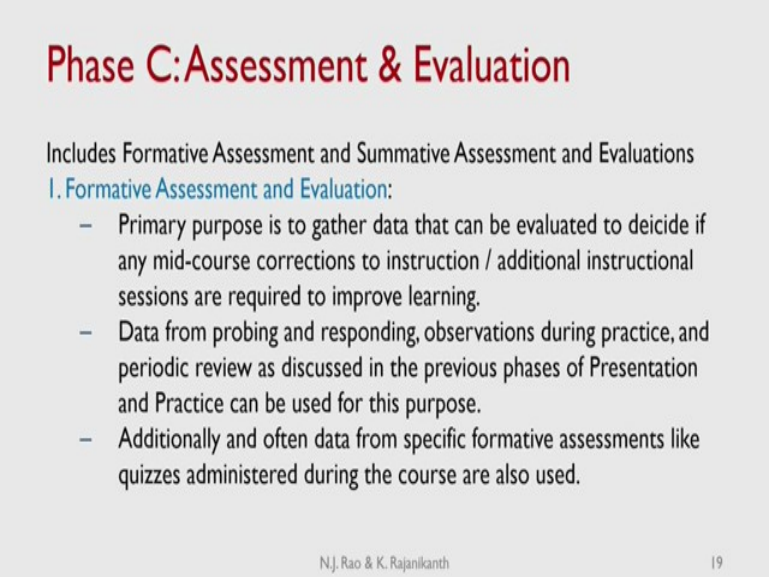

Phase C: Assessment and Evaluation. In any number of units we have emphasized that Assessment and Evaluation is a crucial component of learning; quality assessment drives quality learning. Formative assessment as well as summative assessment and evaluations are essential. Formative assessment and evaluation - primary purpose is to gather data that can be evaluated to decide if any midcourse correction to instruction or additional instructional sessions are required to improve the learning. So, the primary purpose of formative assessment is diagnostic in nature.

Data that we have got earlier from probing and responding; observations made by the instructor during the practice; and the periodic review - all these activities do give considerable amount of data to the instructor. The instructor can use all this data in determining the need for any midcourse correction, as well as the need for any additional instructional sessions.

Additionally, we can also have very specific formative assessments administered; like quizzes during the course. Quite often actually teachers use these kinds of additional specific formative assessment instruments. Apart from the regular probing and responding, observations during practice and periodic review, specific assessment instruments could be administered for formative assessment purposes.

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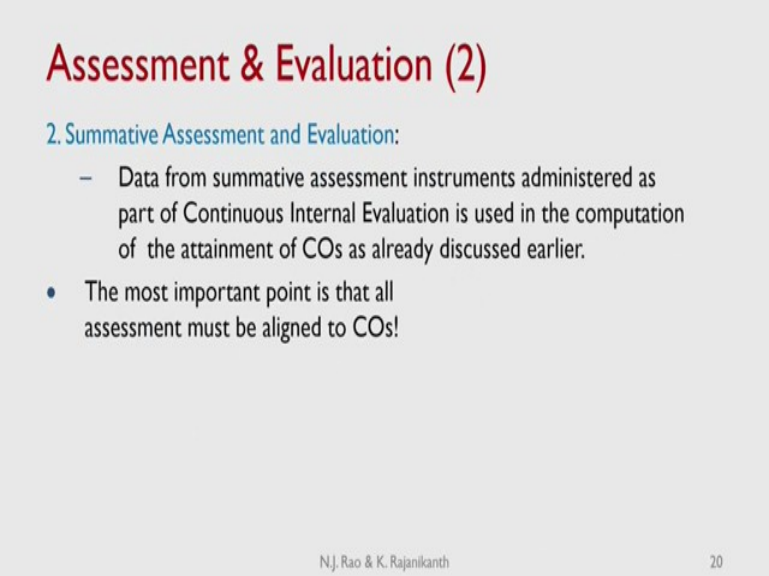

Summative assessment and evaluation: Basically, data from the summative assessment evaluation; the instruments are administered as part of the continuous internal evaluation; that is used in the computation of the attainment of COs as already discussed earlier. But the results from summative assessment during continuous internal evaluation can be used for formative purposes also; to determine if any midcourse corrections are required, if any particular CO/competency is posing problems for majority of the students, necessitating additional instruction. Though the assessment instruments' primary purpose is summative in nature, the data can certainly be used in a formative manner also.

Of course, the most important point, as we emphasized many times, is that all assessment must be aligned to the COs. With respect to semester end examination of course, there is not much we can do in terms of providing feedback to the students, because already the students have completed this class.

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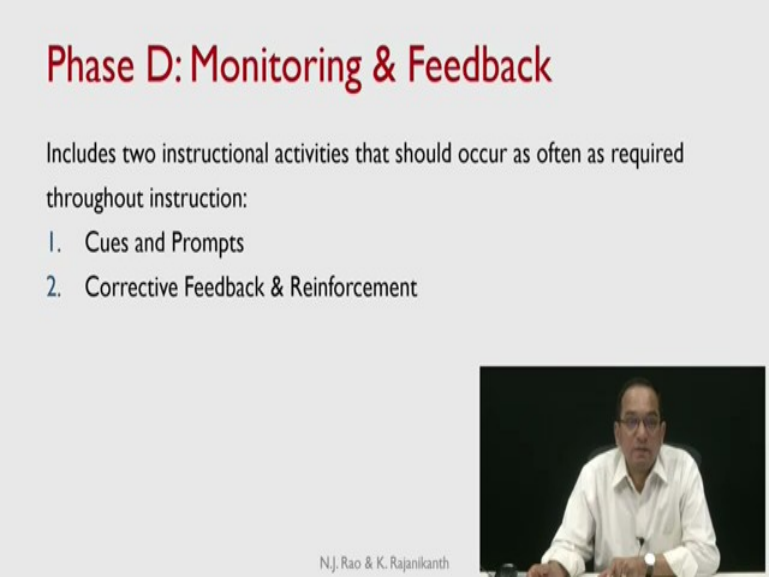

Then finally, phase D - monitoring and feedback includes two instructional activities that should occur as often as required throughout instruction, Cues and prompts; corrective feedback and reinforcement.

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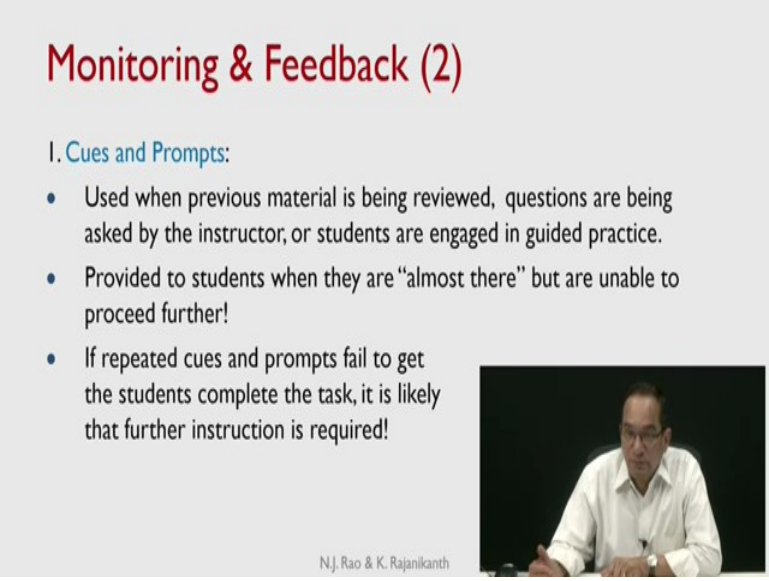

Cues and prompts are used when the previous material is being reviewed, questions are being asked by the instructor that is during probing, or students are engaged in guided practice. Essentially the idea of these cues and prompts is: when the students are almost near the solution, but still are unable to proceed further; there is a small sticky point where the students are really getting blocked; so, the instructor could help the students by providing a cue or a prompt which helpfully will trigger appropriate responses from the students, so that they can complete that task.

If repeated cues and prompts fail to get the students complete the task, it is likely that further instruction is required. There are gaps in the students' understanding and it may be necessary to supplement the learning with additional material or further instruction by the instructor. So, these cues and prompts are supposed to help the learners overcome any minor stumbling blocks which exist in their path.

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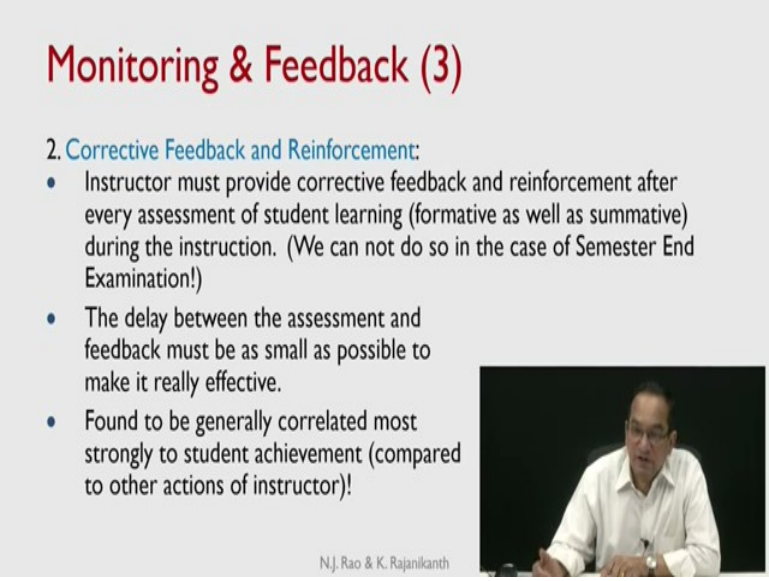

Corrective feedback and reinforcement are again very essential. Instructor must provide corrective feedback and reinforcement after every assessment of student learning - formative as well as summative during the instruction. Of course, as I mentioned, semester end examination is an exception; we cannot really provide any feedback probably after the semester end examination.

The delay between the assessment and feedback must be as small as possible to make it really effective. This is another very important component that all instructors must

remember - that the delay between the assessment and feedback must be as small as possible. If you conduct an internal assessment test, as quickly as possible, it must be evaluated and corrective feedback must be provided to the students.

It is also found to be generally correlated most strongly to student achievement (compared to any other action that the instructor can take). It looks surprising, but there is considerable amount of evidence to show that the faster, the quicker, the feedback provided to the students is, the better will be the students' learning. So, the delay between assessment and feedback must be as small as possible.

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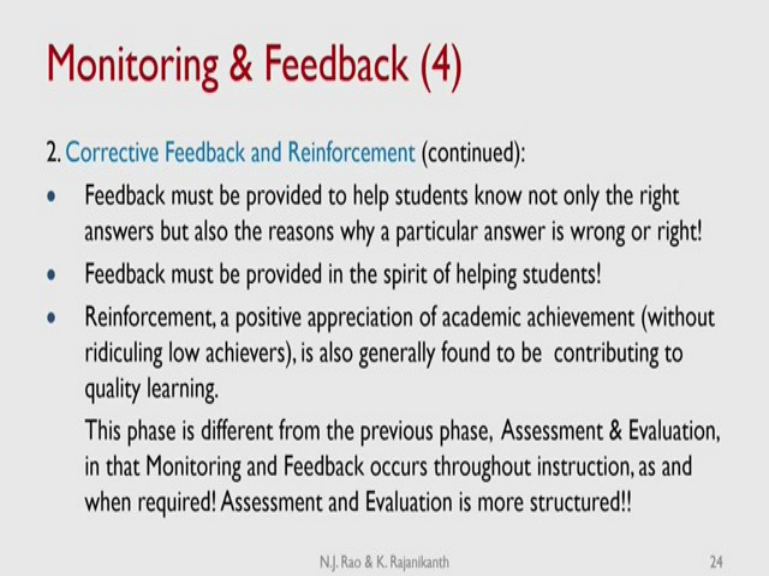

Feedback must be provided to help the students know not only the right from the wrong, but also the reasons why a particular answer is wrong or right. The students must have a complete in-depth understanding of the knowledge that is being imparted. Feedback must be provided in this spirit of helping the students. So, obviously, a kind of a ridiculing or the kind of comments which essentially disturb the student should be avoided. It is in, more in, the nature of supporting/helping the students to learn better that the feedback must be provided.

Reinforcement - a positive appreciation of the academic achievement also helps the students to become more motivated. Of course when this is done we should ensure that we are not ridiculing the low achievers. There is no disparaging kind of comparison; but a positive appreciation does help students. A positive appreciation does help better

motivation. So, reinforcement can be done and that is also found to be contributing to quality learning.

This phase is different from the previous phase (assessment and evaluation,) in the following sense: Assessment and evaluation is quite structured; it happens in a very, very structured fashion at scheduled times; whereas, monitoring and feedback occurs throughout the instruction as and when required.

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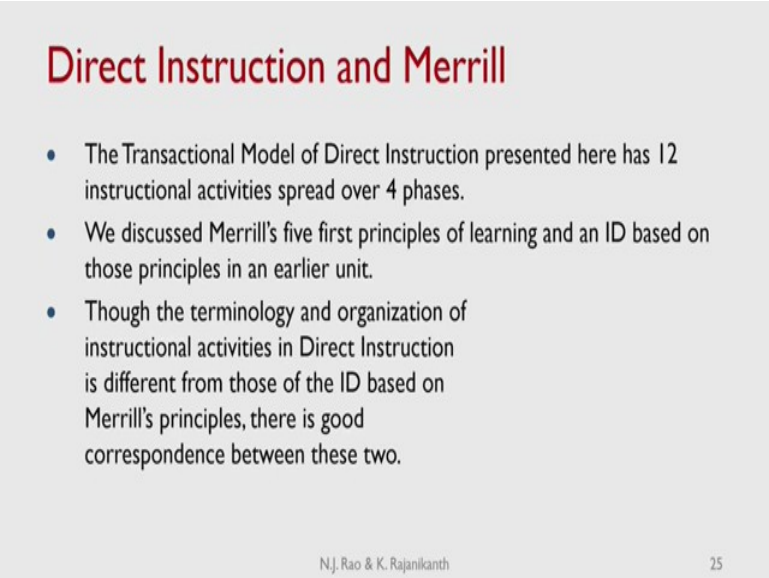

The transaction model of direct instruction presented here has 12 instructional activities spread over 4 phases (we have seen that). We discussed Merrill's five first principles of learning and an ID based on those principles in an earlier unit. Though the terminology and organization of instructional activities in direct instruction model is different from those of the ID based on Merrill's principles, there is good correspondence between these two. In spirit, they are quite similar. The actual terms used are different.

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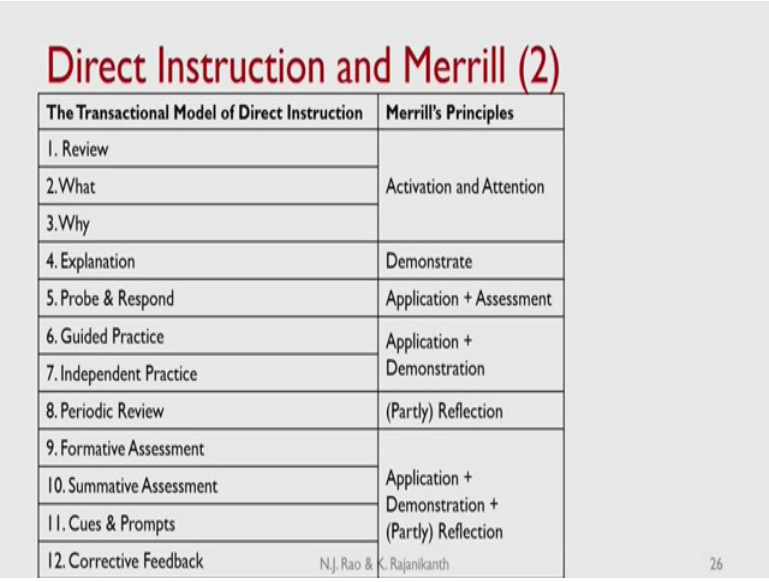

We can see this comparison here very easily, the first three activities - review, what and why - they correspond to the activation and attention of the ID based on Merrill's principles or Merrill's principle of activation. Explanation is obviously the demonstrate; Probe and respond is both application and assessment together, because the students are applying the knowledge learned and the teacher is to some extent assessing what is the quality of their learning.

Then guided practice, independent practice are both application and demonstration; students are applying their newly acquired knowledge and skills and instructor, when necessary, is also demonstrating. Periodic review partly addresses the reflection principle of Merrill. Then, formative assessment, summative assessment, cues and prompts, corrective feedback - essentially this is a combination of application where students apply their knowledge and skills and demonstration - where the instructor, based on the need, demonstrates the knowledge and skills required; and partly reflection where the students integrate the newly acquired knowledge with the knowledge and skills which they have already acquired in the earlier units.

Basically there is a considerable kind of mapping between these two though the terms are different. We need to see this correspondence between this model and the Merrill's principles.

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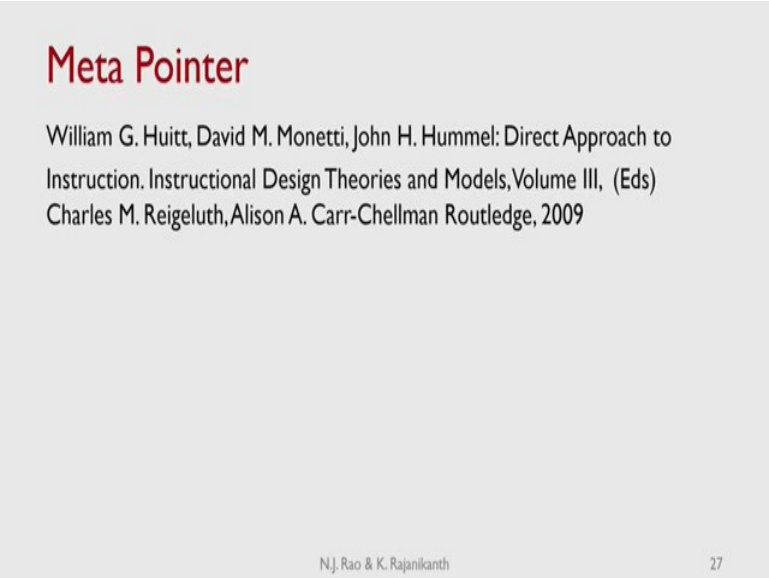

There is an extremely good reference available, where the actual practices and the empirical data from the actual practices and implementation of the direct approach instruction model are available and if you are interested you can refer to these to see what kind of empirical data is available to support these kind of theoretical principles.

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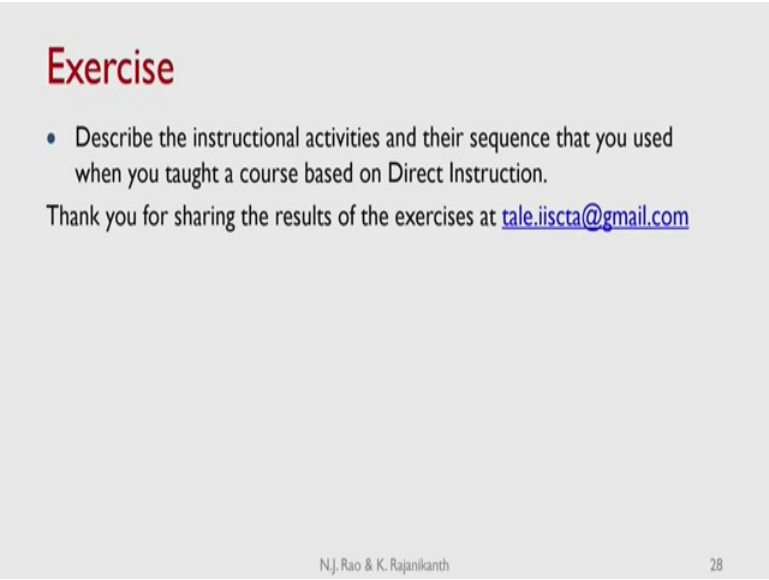

Exercise: Describe the instructional activities and their sequence that you used when you taught a course based on direct instruction.

Thank you for sharing the results of the exercise at tale.iiscta@gmail.com.

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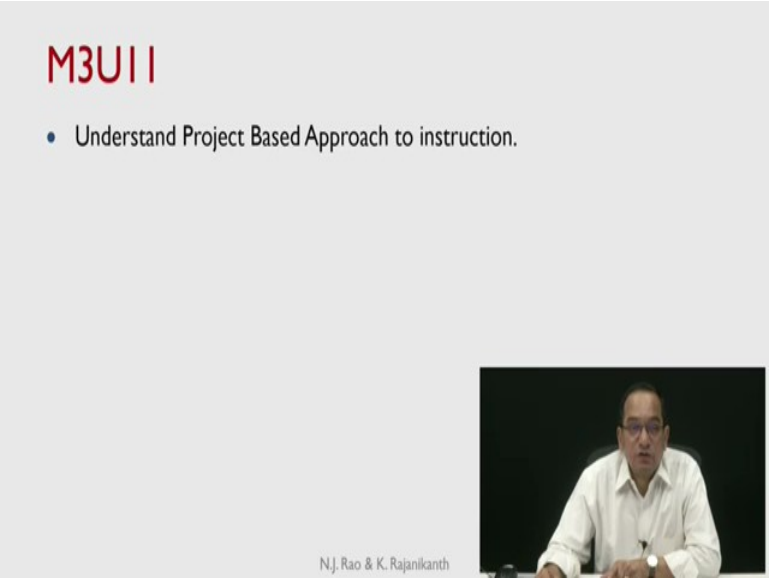

In the next unit, we will try to understand project based approach to instruction. As mentioned earlier, there are several instructional approaches and though the broad principles of Merrill are applicable, the specific approaches do differ in the details of how they look at the learning by the students. We have seen the transaction model of direct instruction. In the next 3-4 units, we look at some other popular approaches to the instruction.

In the next unit, we look at project based approach to instruction.

Thank you and we will meet again.