NBA Accreditation and Teaching - Learning in Engineering (NATE)
Professor K. Rajanikanth
Department of Electronics Systems Engineering
Indian Institute of Science, Bengaluru
Lecture 40 - Principles of Instruction Design

Greetings, welcome to Module 2, Unit 19 on Principles of Instruction Design. Evidently, instruction has to take into account the principles of learning also, thus this unit would discuss principles of learning as well.

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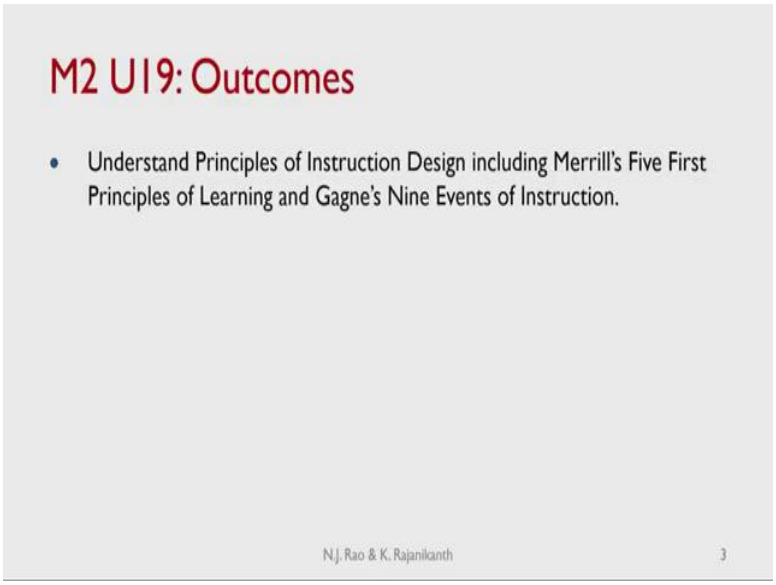

In the earlier unit, we understood how to use a variety of instructional components in classroom. The outcomes for this unit would be, understand principles of instruction design including Merrill's five first principles of learning and Gagne's nine events of instruction.

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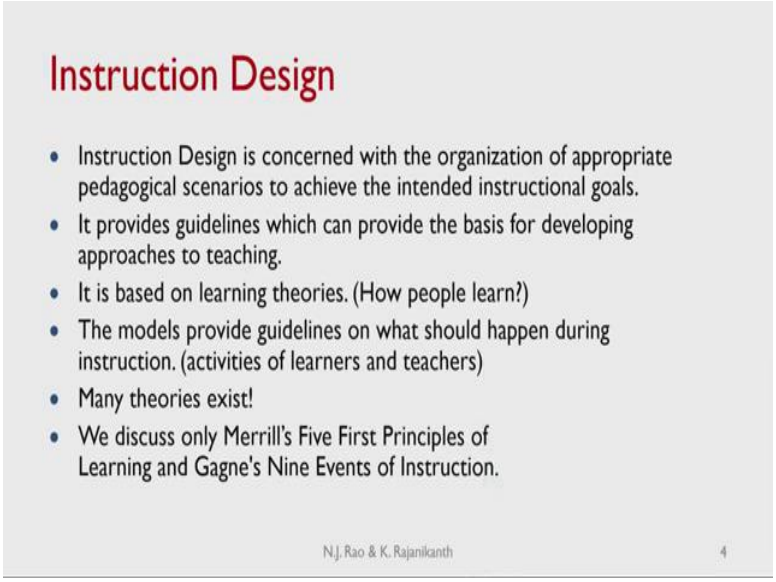

Instruction design is concerned with the organisation of appropriate pedagogical scenarios to achieve the intended instructional goals. These goals would be, to ensure that the students attain and demonstrate the planned course outcomes as well as competencies. The instruction design provides guidelines which can provide the basis for developing approaches to teaching. Evidently, instruction has to take into account the learning by the students, so instruction design is based on learning theories also.

How people learn comes into the picture of instruction design. The models provide guidelines and what should happen during instruction, the activities of learners and teachers. There are many theories of instruction design, we discuss only Merrill's five first principles of learning and Gagne's nine events of instruction. There are many other models for instruction design, there are many models which provide micro level details of how a classroom should be organised.

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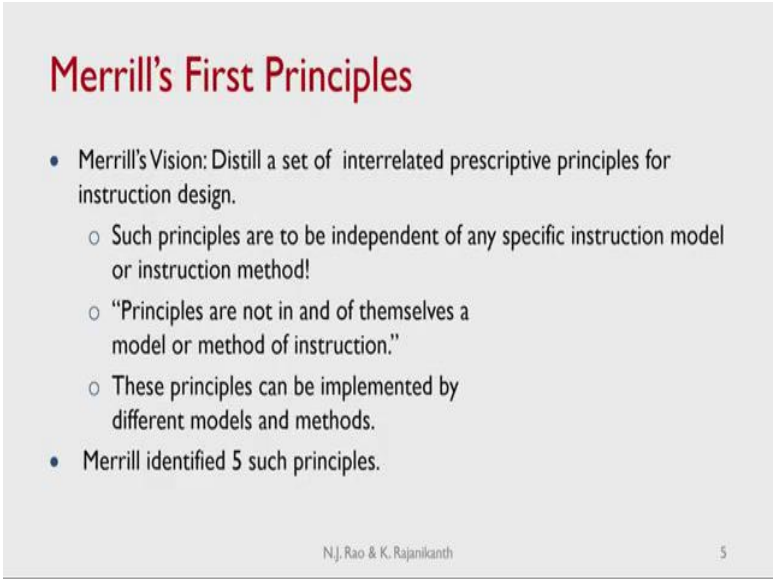

Merrill's vision was to distill a set of interrelated descriptive principles for interaction design. These principles are prescriptive to the extent that an instruction design implements these principles the instruction design will be of higher quality. Such principles are to be independent of any specific instruction model or instruction method, any model or method of instruction can incorporate these principles.

Principles are not in and of themselves a model or method of instruction, a model which is the choice of instructor can incorporate these principles in order to become a model of good quality, these principles can be implemented by different models and methods. Merrill identified five such principles after exhaustively analysing a large number of models proposed in the literature and trying to figure out the principles which are common to all these models which have been really implemented in practice and found to be effective.

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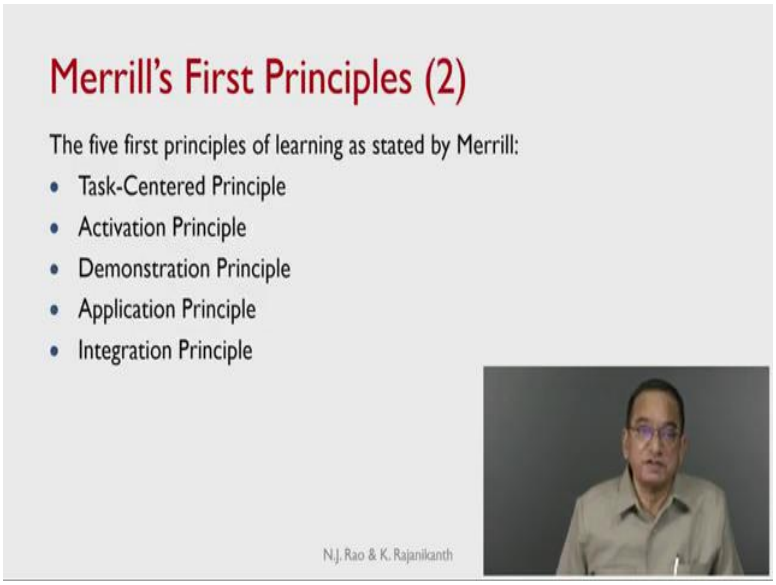

There are five such principles, they are task centred principle, activation principle, demonstration principle, application principle, integration principle.

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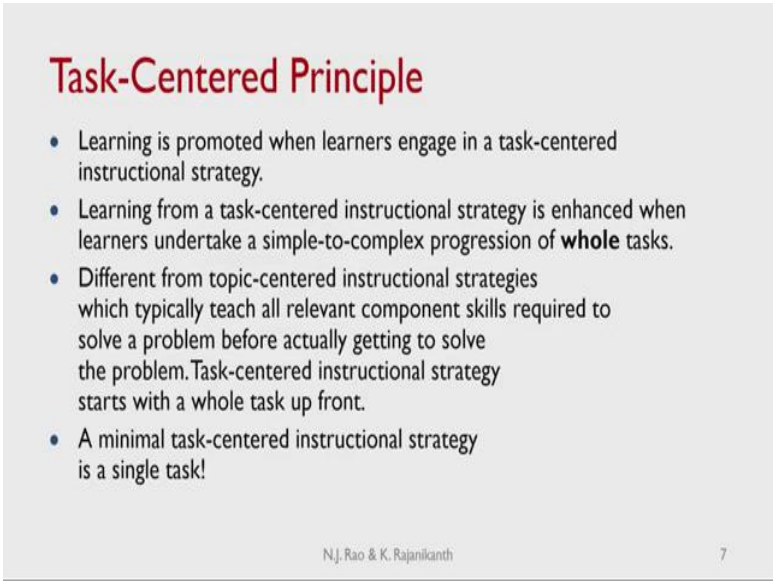

The task centred principle is a major theme around which rest of the principles are interwoven. Learning is promoted when learners engage in a task centred instructional strategy. The learning from a task centred instructional strategy is enhanced when the learners undertake a simple to complex progression of whole tasks. Now, the task centred principle is different from topic centred instructional strategies. Topic centred instruction strategies

typically teach all relevant component skills required to solve a problem before actually get in to solve the problem.

The required skills are covered first, and the actual solution of the problem happens later. Task centred instructional strategies start with a hole task upfront, the task presented to the students initially itself is a whole task. A minimal task centred instruction strategy is a single task, but Merrill suggest that, the instruction can be more effective if the students are made to go through a series of tasks, tasks ranging from simple difficulty levels to progressively higher difficulty levels.

So, learners undertake a simple to complex progression of whole tasks, however in a given situation, instructor may have to do with a single task also, but even then the tasks should be a whole task.

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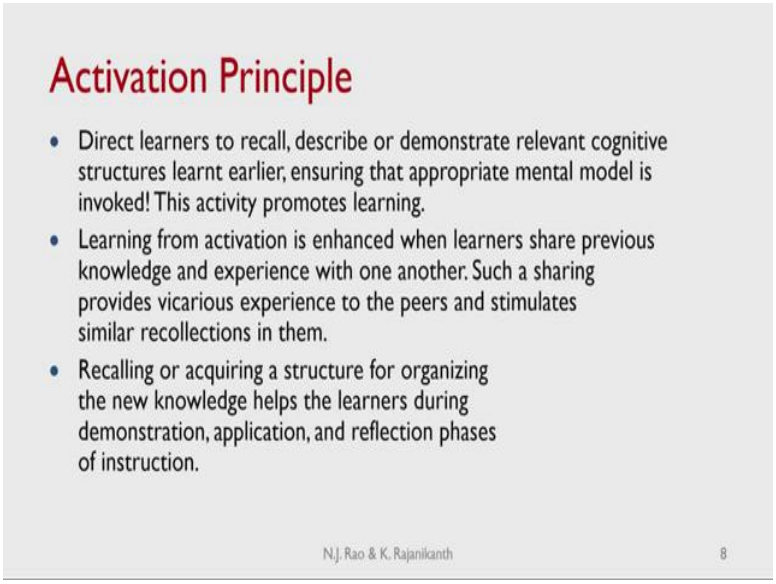

The second principle is activation principle, direct learners to recall describe or demonstrate relevant cognitive structures learnt earlier ensuring that appropriate mental model is invoked. This activity promotes learning according to the activation principle, that means the students are made to recall the relevant cognitive structures learnt earlier. Learning from activation is enhanced when learners share previous knowledge and experience with one another, such a sharing provides vicarious experience to the peers and stimulates similar recollections in them.

Some students may be able to recollect the earlier knowledge, the earlier problem solving skills, the earlier mental models more vividly, and this in turn may promote similar recall from the other students also. So, learning from activation is enhanced when learners share previous knowledge. Recalling or acquiring a structure for organising the new knowledge helps the learners during demonstration, application and reflection phases of instruction, thus, it is required to ensure that students recollect the prior knowledge and they invoke an appropriate mental model ready to receive the new knowledge.

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Learning is promoted when learners observe a demonstration of the skills to be learnt, that is consistent with the type of content being thought. So teacher must demonstrate the skills which the students have to acquire. Learning from demonstration is enhanced by peer discussion and peer demonstration. Once the teacher demonstrate the skills, the students must discuss among themselves what is involved in the new knowledge that they have to gain. And if they can demonstrate to each other the newly acquired skills, their learning will get promoted.

Learning is also enhanced when learners are guided to relate an organizing structure to specific instances. If they can place the newly acquired knowledge in a framework in an organizing structure, then their learning would be enhanced. Learning from demonstration is also enhanced when learners observe through media that is relevant to the content, depending upon what is the content that is being demonstrated, the teacher must use appropriate media.

They can be text or graphics or animations or simulations whatever suits best the content must be used by the teacher.

And learner guidance is quite useful in making learner focus on critical elements of the demonstration. While the teacher is demonstrating the content, it would be better if the teacher can guide the learners to focus on the critical elements of the demonstration, this will promote learning.

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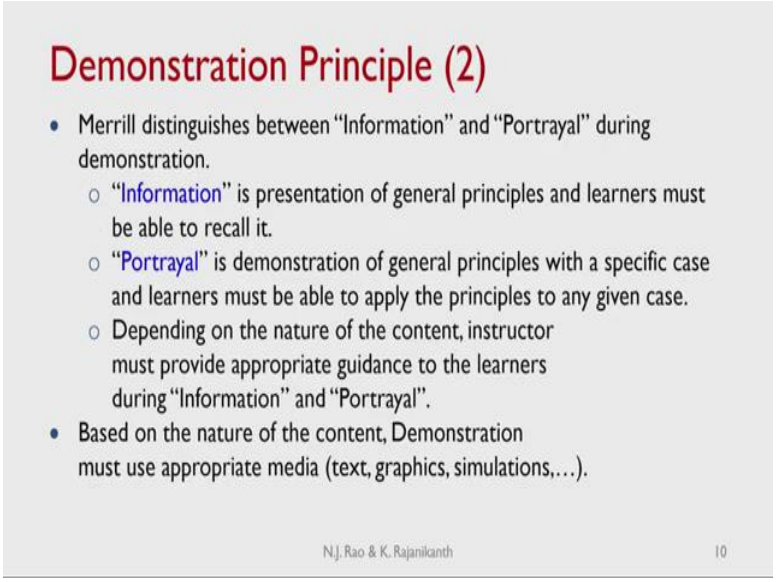

Merrill distinguishes between information and portrayal during demonstration, there is an information and portrayal phase during demonstration. Information is presentation of general principles and learners must be able to recall it, so information is about general principles. Portrayal is demonstration of general principles with specific cases and learners must be able to apply the principles to any given case. So teacher demonstrates the applications of general principles with specific case.

Students must be able to apply these principles to any given case. Depending on the nature of the content, instructor must provide appropriate guidance to learners during information and portrayal. Demonstrations must obviously use appropriate media as I mentioned, it could be text or graphics or simulations etc.

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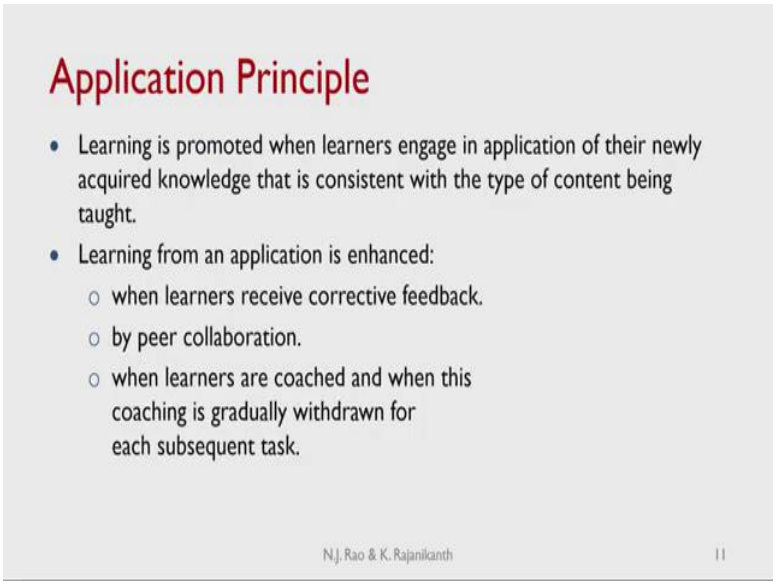

Then we have the application principle. Learning is promoted when learners engage in application of their newly acquired knowledge, that is consistent with the type of content being taught. Learning from an application is enhanced when learners receive corrective feedback. After demonstration, when learners are trying to apply the newly acquired knowledge to specific cases, teacher must evaluate the response of the students and provide them corrective to feedback. It has been proved in many empirical studies that such corrective feedback is extremely important in enhancing the quality of learning by the students.

So learning from an application is enhanced when learners receive corrective feedback. It is also important that the teacher must use their feedback in a positive and constructive way to help the learners, there should not be any ridicule or there should not be any sense of inferiority induced in the minds of the students. Their feedback must be provided in a positive, constructive way to help the learners improve their skills in applying the newly acquired knowledge. So, learning from application is enhanced when learners receive corrective feedback.

And the delay between the application by the students and providing of the feedback by the teachers should be as minimum as possible for the feedback to be more effective. Learning from an application is enhanced by peer collaboration also, when learners collaborate together in their efforts to apply the newly acquired knowledge their learning improves. Peer

collaboration helps create a social environment which promotes learning by the students. So learning from an application is enhanced when the students collaborate together.

Learning is also enhanced when learners are coached and when this coaching is gradually withdrawn for each subsequent task, with the initial tasks the teacher may provide considerable amount of guidance to the students but as the learners progress through a series of tasks, teachers must gradually withdraw their coaching. Students must be able to apply the knowledge more or less independently as they move through a progression of whole tasks.

So learning is enhanced when learners coached and when this coaching is gradually withdrawn for each subsequent task.

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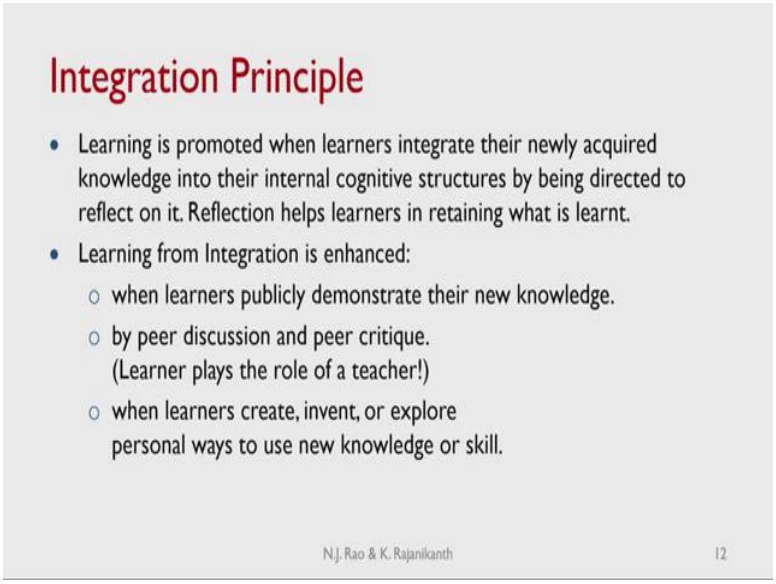

Integration principle, learning is promoted when learners integrate their newly acquired knowledge into their internal cognitive structures by being directed to reflect on it. Having gone through demonstration and application, the students must be able to integrate the new knowledge into the structures which they already possess, thus the new structure would be the integration of the new knowledge with the earlier knowledge and teacher can help the students in this process by directing them to reflect on it.

Reflection helps learners in retaining what is learnt, learning from integration is enhanced when learners publicly demonstrate their knowledge. When the learners demonstrate their knowledge publicly, they would be forced to reflect on their newly acquired knowledge, they would be forced to articulate their new understanding and this would promote learning. And

learning is also enhanced by peer discussion and peer critique. Students can discuss among themselves regarding the new knowledge acquired, it is also good if a student plays the role of a teacher, presents the material and the other students provide a critique of it.

Learner plays the role of a teacher, we all know that when one tries to teach any content, the understanding by the teacher improves, thus if the students can be made to play the role of a teacher temporarily by asking them to publicly demonstrate the new knowledge, then their learning would be enhanced. Learning from integration is enhanced also when learners create, invent or explore personal ways to use the new knowledge or skill.

This may be sometimes very difficult in the short run but if learners can create, invent personal ways to use the new knowledge, then their learning would be much better but often this would require longer duration and that may not be possible in most of the instructional models. However, if the students can be helped to engage in this activity of creating or inventing or exploring personal ways to use their newly acquired knowledge or skill, then certainly it would enhance their learning.

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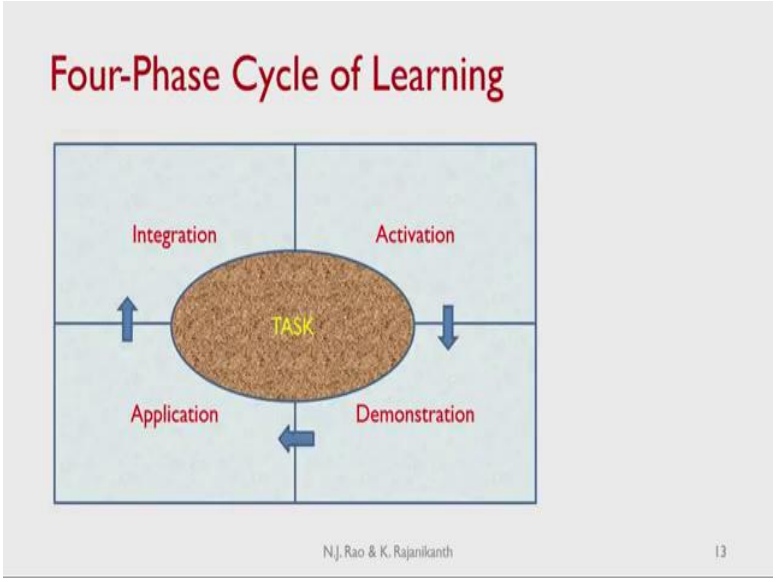

Thus, we see that there is a four phase cycle of learning, the four phases are, activation, demonstration, application and integration and these four phases are centred around the task, the centred principle is the key ingredient, it is the glue which links all these four activities. We start with the activation phase that is followed by the demonstration phase and then we have the application phase and that is followed by the integration phase. And all these four phases occur in the context of a whole task or a series of whole tasks.

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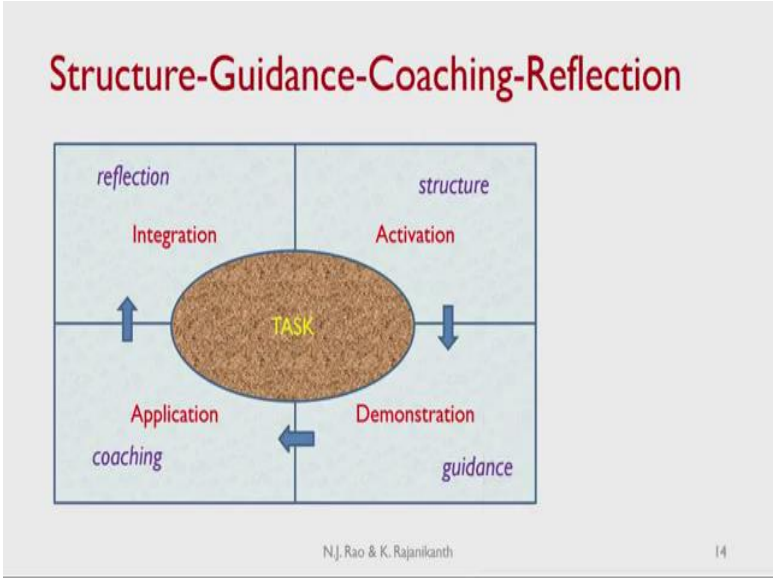

If you look at the role of the teacher, during the activation phase, the teacher help the students recall an earlier structure, an earlier cognitive model, and thus the role is here to ensure that the students recollect an appropriate model suitable for acquiring the new knowledge. The model is of the earlier knowledge, so the first phase is concerned with structure. During the demonstration phase, the teacher provides guidance to the students.

Teacher demonstrates the new knowledge and the skills and guides the students in focusing on critical aspects of the new knowledge and in helping them understand the new knowledge in the light of the model of the earlier knowledge that they already have invoked. During the application phase, the student is trying to apply their newly acquired knowledge or skills on specific cases and teacher plays the role of a coach, teacher guides the students in their efforts to apply the new knowledge and as students work through a series of whole tasks, progressively from lower difficulty to higher difficulty and higher complexity, the teacher withdraws the coaching.

Initially, teacher may provide extensive coaching but as the students progress through the tasks, the coaching is gradually withdrawn. So, during the application phase teacher plays the role of a coach. Then finally, during the reflection phase the students are helped to integrate their newly acquired knowledge with the knowledge that they already poses. And this phase is essentially a consolidation phase and this helps the students to retain their knowledge for longer periods, it is essential that this reflection phase is not ignored. What time the

instructional components can be used to help the students during this reflection phase will be discussed in the next unit.

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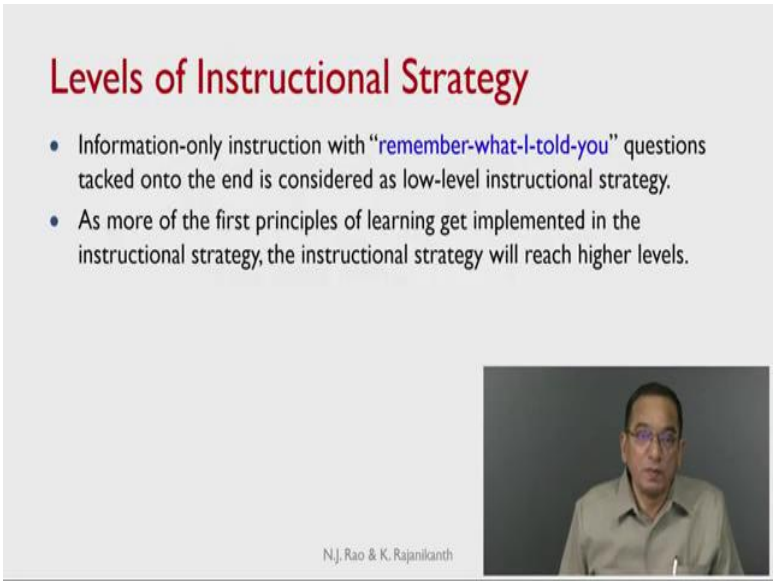

Merrill considers that the levels of instructional strategy can become higher quality levels as they incorporate more and more of these five principles. As more of the first principles of learning that implemented in the instruction strategy, the instruction strategy will reach higher levels and Merrill observed that information only instruction with, remember what I told you questions tacked onto the end is a very low level instructional strategy.

Merrill has observed that any such strategy which is information only does not lead to good quality learning by the students, a given model may or may not incorporate all the five principles of Merrill but as the instruction incorporates more and more of these principles, the instruction tends to be of higher quality.

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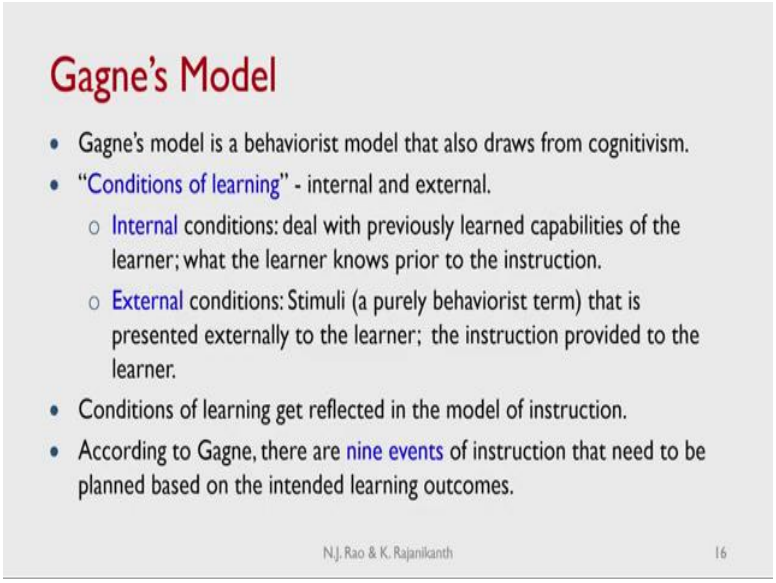

Now let us look at the Gagne's model of nine events of instruction. Gagne's model is a behaviourist model but it also draws from cognitivism. Gagne makes conditions of learning as the focus of his model, he distinguishes between internal and external conditions of learning. Internal conditions deal with previously learned capabilities of the learner, in other words what the learner knows prior to the instruction. Gagne calls this as internal conditions of learning.

The external conditions, stimuli a purely behaviouristic term that is presented externally to the learner. The instruction provided to the learner, Gagne calls this as external condition. Conditions of learning get reflected in the model of instruction, according to Gagne, there are nine events of instruction that need to be planned based on the intended learning outcomes.

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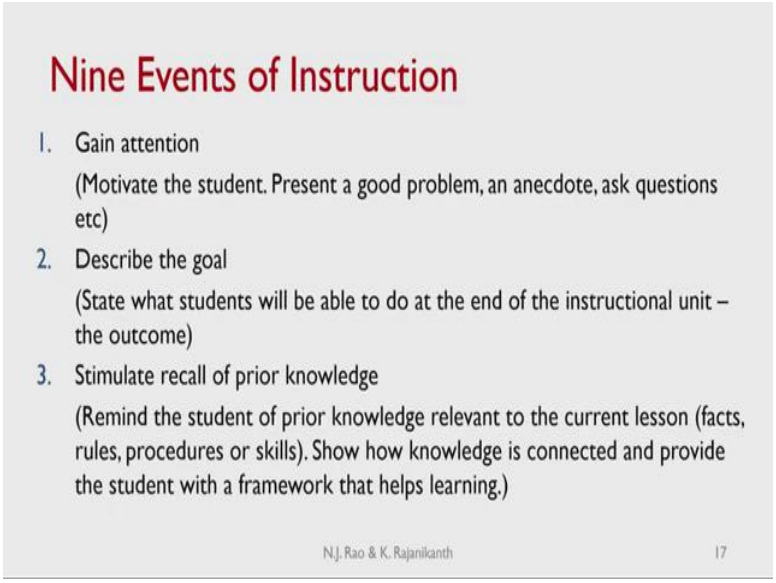

The first event of instruction according to Gagne is gain attention, before learning can commence, students must pay attention to what is being taught in the classroom. So it is important to gain the attention of the students before the actual instruction commences, how does one gain the attention of the students? There can be several instructional components that are possible anecdotes to motivate the students presenting a good problem to which students can get connected easily.

Sometimes teacher can ask questions, which stimulate the students into thinking about the nature of the new content that is to be presented. There can be several techniques to gain the attention but without gaining the attention of the students, if one proceeds with instruction it is likely that the learners really will not be able to observe the new content that is being presented.

The second event is to clearly describe the goal, what the students are expected to be able to demonstrate at the end of the instruction, this is what we have been calling as an outcome statement, course outcome or competency when the course outcome is expanded into several competencies. Describe the goal, state what students will be able to do at the end of the instructional unit.

The third event is stimulate recall of prior knowledge, remind the students of prior knowledge relevant to the current lesson, the prior knowledge could include facts, rules, procedures or skills. Show how knowledge is connected, in other words show that the prior knowledge is

linked to the new knowledge that they are going to gain. So teacher must provide the student with a framework that helps learning, one can easily see that this also relates to the Merrill's principle of activation.

Many of the good instructional models do share several features like this. So the third event is stimulate recall of prior knowledge.

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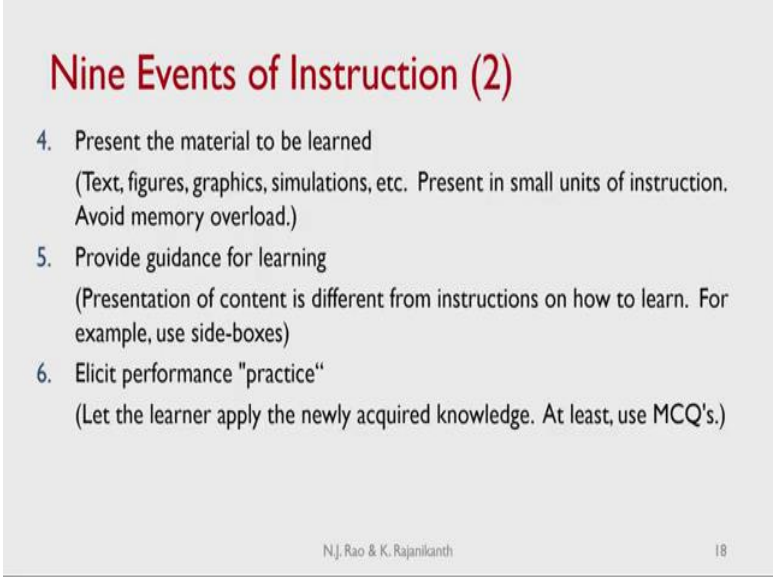

The fourth event is present the material to be learnt, the actual new content is presented now. It could be in form of text or figures or graphics or simulations and so on. Present the new information in small units of instruction, we have already seen in the earlier unit on how brains learn that if a single capsule of a large time of about 50 minutes say is presented then it is likely that there will be an overload on the memory structures of the brain.

Thus, present the new information in small units of instruction, typically 15 to 20 minutes, this will avoid the memory overload. The fifth event is, provide guidance for learning. Presentation of the new content is different from instructions on how to learn, not only the teacher must present the new content but the teacher must help the student in learning the new content. So teacher must provide guidance for learning, for example, one could use side boxes which show what are the essential points of the new information being presented and how to learn them, how to integrate them with their prior knowledge and so on.

Then Elicit performance practice, let the learner apply the newly acquired knowledge. If time does not permit the teacher to allow the students to practice extensively, at least she can use

multiple choice questions and students would be forced to perform some practice at least. So at the minimum level use multiple choice questions, but if time permits teacher can allow the students to practice in the application of the newly acquired knowledge. This is very essential for the students to learn well.

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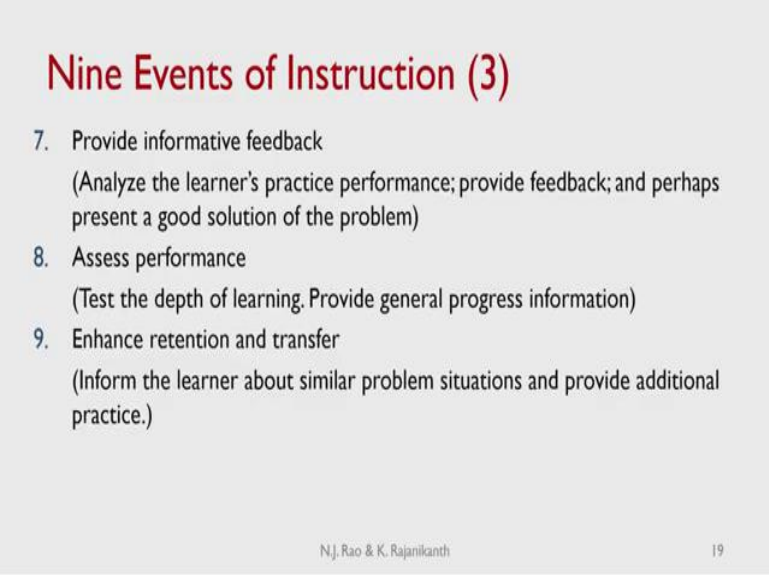

The seventh event is provide informative feedback, we already so while discussing Merrill's principles that providing feedback on the learner performance is found to be the most important event that helps in the quality learning by the students. When learners practice or learners perform if they receive positive feedback, constructive feedback, feedback that helps them to improve their learning, then it will be extremely valuable.

So provide informative feedback is the ninth event of instruction according to Gagne. Analyse the learners practice performance and provide feedback, if required and if possible teacher can present a good solution to the problem also. Teacher can present an ideal solution and students would be able to compare their practice performance against the high quality solution presented by the teacher.

This is not absolutely necessary, it is an optional step if teacher wishes to, she can present a good solution but providing feedback to the students is essential and the eight step is assess the performance, conduct some kind of summative assessment and evaluate the teachers, evaluate the students' performance, test the depth of the learning and if it is possible provide a measure of the general progress of the students. Provide an indication of the extent to which the students are able to understand the new knowledge.

Then the last and final event is help the students to retain their newly acquired knowledge and help them in their ability to transfer this skill to a novel context, this can be done by informing the learner about similar problem situations and by providing them additional practice. This step is not that easy to implement in limited time, however teacher must try to ensure that students are able to transfer their newly acquired knowledge and skills to novel situations.

Teacher must help the students in enhancing the retention and transferring of their skills to new situations.

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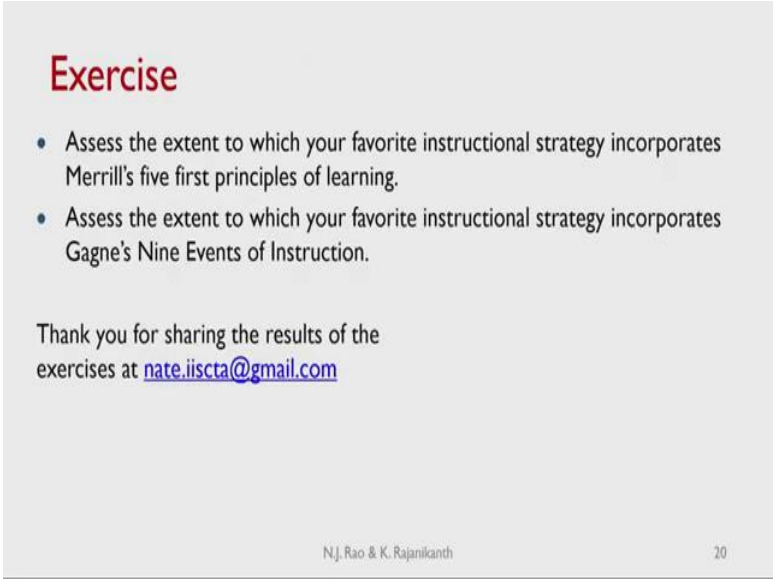

So the Merrill's five principles of learning and Gagne's nine events of instruction are two typical instruction design models. As I mentioned, there are several other models but these two models capture most of the generally useful principles. In the next unit, we will look into some models of direct instruction which incorporate some or all of the features of Merrill as well as Gagne.

An exercise for you, assess the extent to which your favourite instructional strategy incorporates Merrill's five first principles of learning. Another exercise would be to assess the extent to which your favourite instructional strategy incorporates Gagne's nine events of instruction. The nine events of instruction may not be incorporated in the exact sequence in which representation of these events has occurred, but if the instructional strategies that you prefer incorporates these events in any order, please let us know.

Thank you for sharing the result of the exercise at nate.iiscta@gmail.com.

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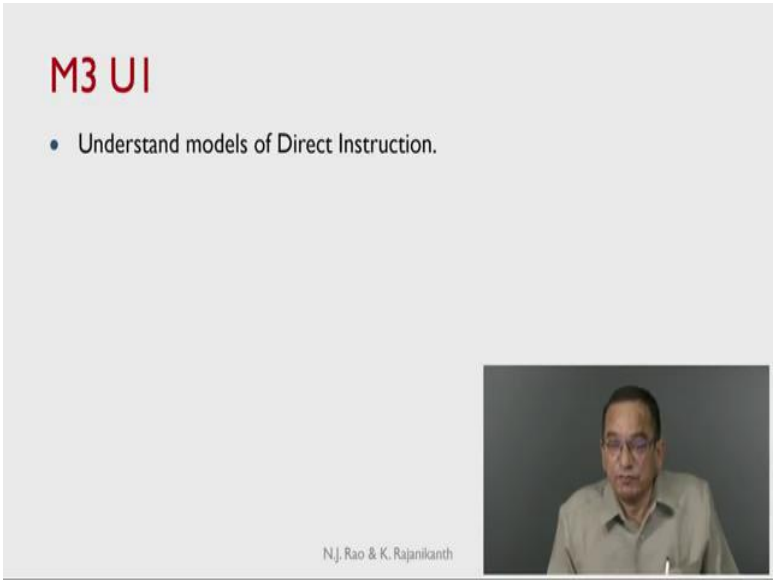

And in the next unit, we will understand models of direct instruction which make use of the Merrill's first principles of learning and or Gagne's nine events of instruction. Thank you and we will meet in the next unit, thank you.