TALE - 2 Course Design and Instruction of Engineering Courses

Prof. K Rajanikanth
Former Principal, MSRIT
Indian Institute of Science, Bengaluru

Lecture – 27
ID Based on Merrill's Principles of Learning

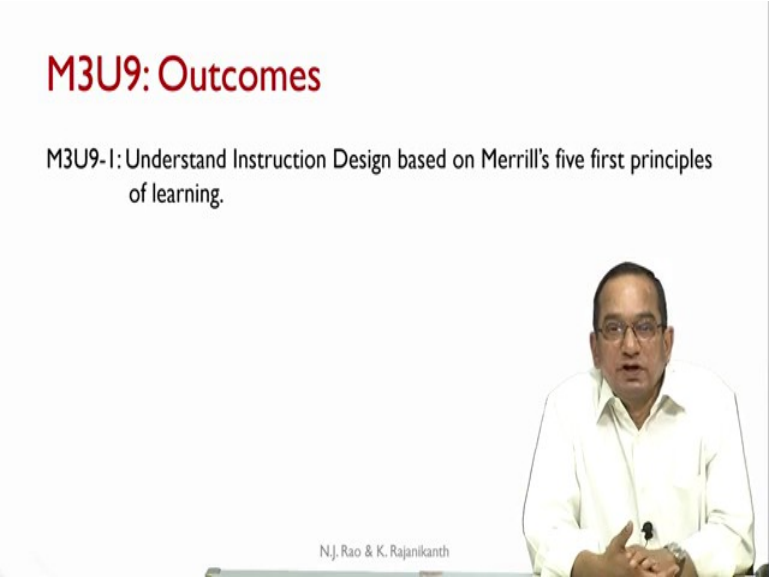
(Refer Slide Time: 00:33)

Greetings. Welcome to Module 3, Unit 9: An ID Based on Merrill's first principles of learning.

(Refer Slide Time: 00:39)

In the last unit, we understood Merrill's five first principles of learning. They do not constitute an instructional design model by themselves. In this unit, we understand instruction design based on Merrill's five first principles of learning.

(Refer Slide Time: 00:52)



This is not unique in any sense; this is one of the possible models which will implement all the five first principles of learning.

(Refer Slide Time: 01:10)

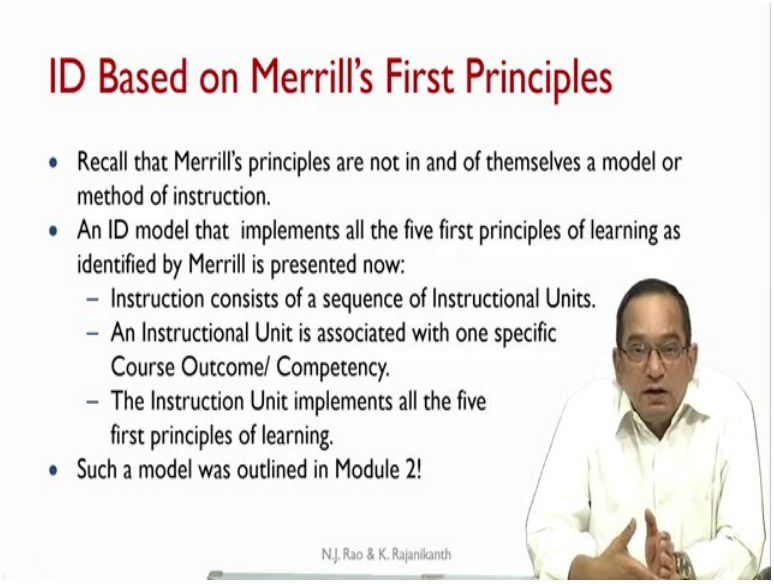
Recalling: The five first principles of learning as stated by Merrill are: task-centred principle, activation principle, demonstration principle, application principle, integration

principle. Very briefly what it means is that the learning must occur in the context of an authentic real world problem that is quite similar to the task that the learners will be required to solve when they practice.

The activation principle essentially says that the learners must recall a mental model based on their prior knowledge which would be helpful in receiving the new knowledge. Demonstration principle says that instructor must first demonstrate the knowledge that the learners are supposed to acquire.

Application principle: Where the learners engage with a task to apply their newly acquired knowledge. Integration principle says that at the end of it the students reflect on the new knowledge acquired, integrated into the existing framework/existing model that they already held and they absorb the new knowledge in the context of a mental model. These are the five principles of learning as stated by Merrill.

(Refer Slide Time: 02:42)

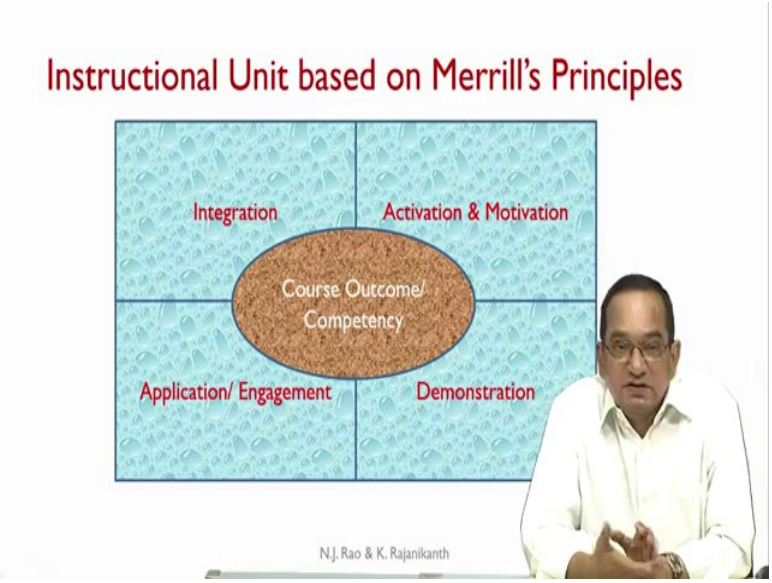


As noted, Merrill's principles are not in and of themselves a model or a method of instruction. An ID model that implements all the five first principles of learning as identified by Merrill is presented now; this is one of the possible models. Here the instruction consists of a sequence of instructional units; an instructional unit is associated with one specific course outcome or competency. Depending upon the nature and complexity of the course outcome, one instruction unit may be associated with an outcome or when the CO is expanded into a set of competencies, one instructional unit

may be associated with one competency. Both are possible; it is up to the instructor - how the instruction is really designed.

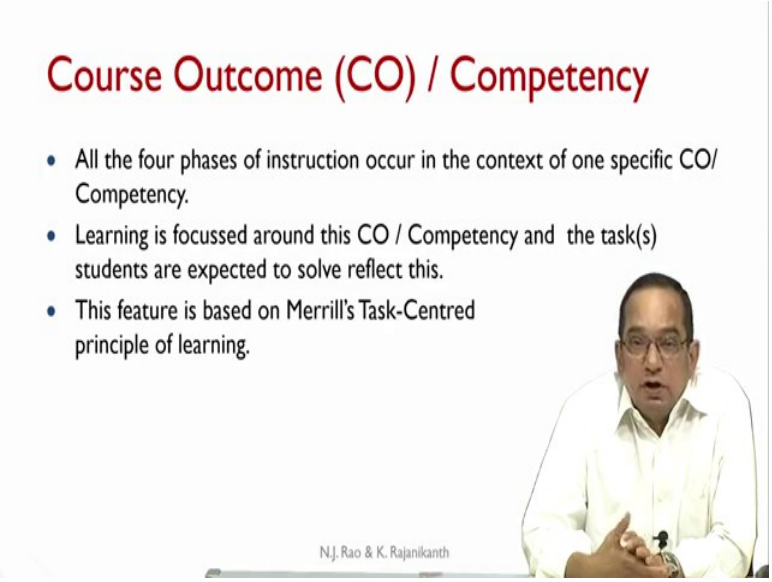
As we saw in an earlier unit on the ADDIE model, there is considerable choice, there are considerable opportunities for instructor to exercise her discussion/ her knowledge of the content to decide on how the instructional units should be organized. But the instructional unit is associated with one specific CO/competency. Instruction itself consists of a sequence of such instructional units. It is at the level of the instructional unit that we implement all the five first principles of learning. Such a model was outlined earlier in module 2. Now, we will explore that in greater detail and see how it is related to or how it implements Merrill's five first principles of learning.

(Refer Slide Time: 04:34)



Given is the diagrammatic representation of instructional unit based on Merrill's principles. The central theme around which the phases of instruction take place would be the course outcome or the competency. Around that, the 4 phases of instruction take place - activation and motivation, demonstration, application/engagement and integration. This is the model, and this is the model for one instructional unit.

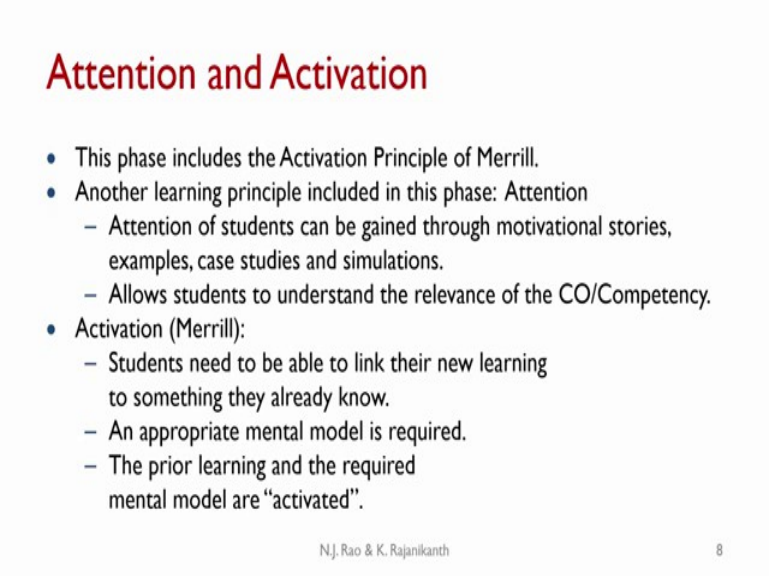
(Refer Slide Time: 05:09)



The course outcome or the competency, depending upon how the instructional unit is designed, plays the role of the task in Merrill's principles. All the 4 phases of instruction occur in the context of one specific CO/competency. Learning is focused around this CO/competency and the tasks students are expected to solve reflect this. That means, the actual task that the instructor presents is essentially based on the CO/competency that is relevant. This feature is based on Merrill's task-centred principle of learning.

This brings focus to the learning and the learning occurs in the context of a very specific competency and the application, the demonstration, the activation and the reflection - all centred on this CO. This plays the role of a task. And Merrill's task-centred principle is implemented here as CO/competency - centred principle.

(Refer Slide Time: 06:23)



The first phase of the instruction is the attention and activation. This is activation phase of Merrill with an additional component which is "attention". This "attention" is implicit in Merrill's principles, but we make this more explicit in this instructional model. And this essentially is a learning principle which states that before we commence the actual instruction, even activation, first we must gain the attention of the learners.

We must make the learners see the relevance of this particular CO/competency. We must make the learners engaged with the classroom which essentially means that the instructor must first gain the attention of the students (which can be gained through motivational stories, examples, case studies, simulations - all are possible,) before we can proceed with the subsequent phases of the instruction.

The instructor can explain how this particular competency is relevant to their profession. They can present suitable case studies. They can give various examples depending upon the specific domain in which they are working.

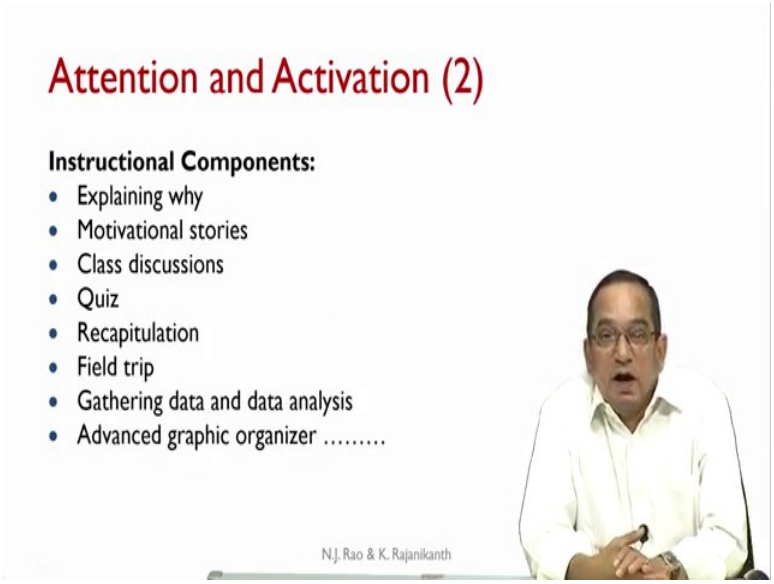
Allow students to understand the relevance of the CO/competency - this is very important. Quite often, it happens that many students do complain at the end of a particular instructional unit or even a course that: 'Yes, I am capable of doing it, but I really do not know why I need to have this competency! What is the relationship of this competency to my profession; it is not clear to me'. And that is not a very good sign of learning.

Attention tries to ensure that students understand the relevance of the particular CO/competency of this instructional unit. Then it is followed by the activation which as Merrill says - 'the students must be able to link the new learning to something they already know.' The instructor must ensure that an appropriate/required/ relevant mental model, is invoked by the students.

The prior learning and the required mental are activated. They are brought to the surface, and in case there is some difficulty with this phase, instructor may have to spend some additional time, engaging the students in some discussion, if required certain additional direct instruction, to ensure that the students are prepared to receive the new instruction.

Depending upon the situational restrictions, sometimes, this phase may take more time. If the students are unable to recall the mental model from earlier learning then instructor has to spend considerably additional effort to help the students recall it; because without that recollection absorbing the new knowledge becomes very difficult. So, the activation phase is very important. As mentioned, depending upon the scenario, instructor may have to spend considerably more time than originally planned to ensure that all the learners are able to recollect this mental model based on the earlier knowledge.

(Refer Slide Time: 10:07)

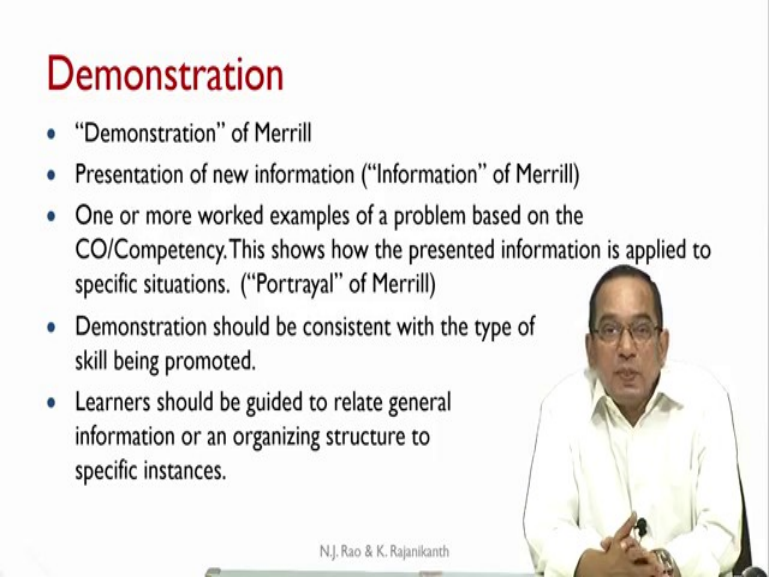


To do this various instructional components can be used. We have seen in the previous units the variety of instructional components that are at the disposal of the instructor. Based on the specificity of the learning context, instructor can pick and choose the

relevant instructional components. It can be “explaining why”, “motivational stories”, “class discussions”, “quiz”, “recapitulation”, “field trip”, “gathering some preliminary data and doing data analysis” etc. It can be a kind of advanced graphic organizer where the interrelationships of the concepts are all shown. It can be some kind of a group discussion. It can be some kind of a recollection by the learners.

There can be a variety of instructional components which can be used; but it is essential that the attention is gained as well as all the learners are able to activate an appropriate mental model based on their earlier learning which makes it suitable and makes it ready for the learners to receive the new knowledge.

(Refer Slide Time: 11:22)



Demonstration - demonstration phase of Merrill: Presentation of new information which is what Merrill calls as information. One or more examples of a problem based on the relevant CO/competency. This shows how the presented information is applied to specific situation. This is what Merrill calls as portrayal. Demonstration should be consistent with the type of skill being promoted which essentially means the cognitive level of the CO/competency involved as well as the knowledge category.

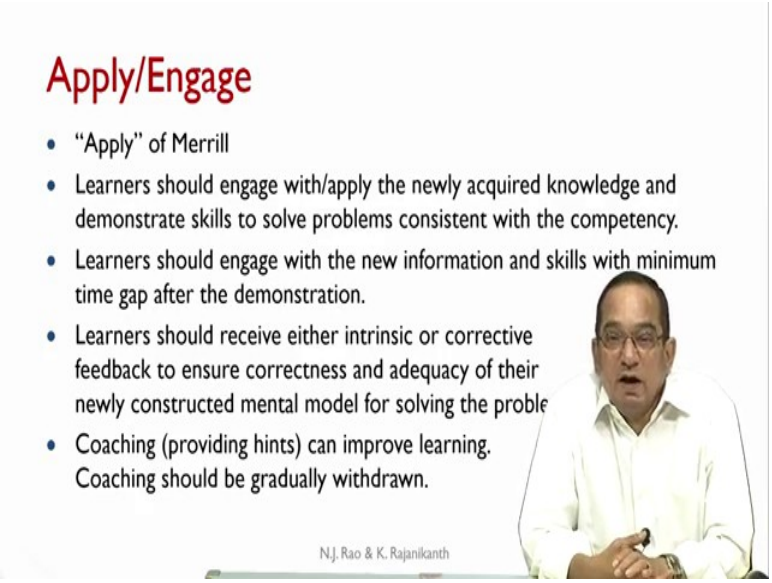
Learners should be guided to relate the general information or an organizing structure to specific instances. They must be able to integrate this into the existing framework later on. But, for that, they need to first have some kind of an organization to the new

knowledge that they have acquired. They must be able to relate the general principles to the specific applications.

Instructor has a choice of instructional components for demonstration purposes; depends upon the CO/competency. It can be an interactive lecture, a multimedia presentation, simulations, conventional black or white board and some example problems that can be presented. Sometimes it can be a field trip, where something is demonstrated. It can be some activity in the laboratory where certain experiments are conducted and the results are demonstrated. It can be again graphic organizers or advanced graphic organizers. Any of these instructional components, any mix is possible - it is totally the responsibility as well as the prerogative of the instructor to pick the relevant instructional components and match them to the requirements as indicated by the CO/competency.

What is most important is that the demonstration is consistent with the CO/competency. (Consistent, both in terms of the level of cognitive process as well as the category of the knowledge.) Otherwise the model is quite flexible and the instructor has considerable freedom, and in fact responsibility to choose relevant instructional components.

(Refer Slide Time: 14:01)



Then the "Apply/Engage" which Merrill calls as the 'Apply': That is the phase in which the newly acquired knowledge is applied by the learners. Learners should engage with / apply the newly acquired knowledge and demonstrates skills to solve problems consistent with the competency. Once again, when we say solve problem, it does not

necessarily mean that it is the application of a procedure; it depends upon the CO/competency. It could be understand level in which case, given a new instance, learners must be able to correctly categorize the class to which the new instance belongs. Classify is one of the sub processes of understand. If the learner is able to classify a new instance correctly that demonstrates the understand competency.

When we say solve a problem, we are using it in a broad sense. Consistent with the CO/competency, the learners must be able to demonstrate their ability to solve a problem, in a generic sense, relevant to that CO/competency. So, learner should engage with the new information and skills with minimum time gap after the demonstration. This is an extremely important principle of Merrill and quite often, in the classroom scenario, some of the instructors may be missing it.

If there is a long gap between the acquisition of the new knowledge and the application of that by the learners, the learning is most likely to suffer. The more quickly learners begin to engage with the problem using their newly acquired knowledge; the better will be the learning. The gap between demonstration by the instructor and application by the learners should be as small as possible; probably even as low as 20 to 25 minutes if it is feasible. In some cases, it may not be really that feasible; but effort must be made to ensure that learners engage with a whole task as quickly as possible after acquiring new information.

Learners should receive either intrinsic or corrective feedback to ensure the correctness and adequacy of their newly constructed mental model for solving problems. Depending upon again the CO/competency, appropriate feedback must be provided to the learners. This also must be as immediate as possible. The demonstration, the application and the feedback - they must occur with very short gaps in between them for the learning to be really deep.

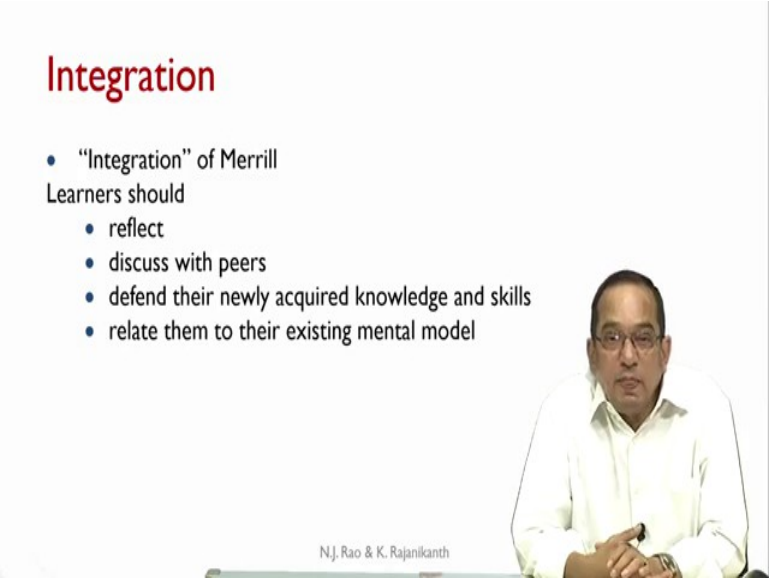
The instructor must ensure that proper feedback is provided to the learners as early as possible after they demonstrate the ability to apply their knowledge to a new problem. Once learners engage with the problem, they must receive feedback as quickly as possible. This engaging with the problem could be a quiz, an assignment or a small term paper; whatever be the nature of the actual technique used to have the students engage with the problem; feedback must be provided at as much small interval as possible.

Coaching (providing hints) can improve learning, but coaching should be gradually withdrawn. In the initial stages coaching maybe more extensive; problems are actually of lesser complexity, but coaching is more extensive. But as learners begin to apply their knowledge to more complex problems and as they gain their confidence, coaching should be a gradually withdrawn. The objective would be that at the end, students must be able to solve complex problems all by themselves with zero coaching by the instructor. That should be the progression of the tasks on which the students work.

(Refer Slide Time: 18:32)

We have fairly large variety of instructional components which can be picked up by the instructor. Note making, summarization, individual problem solving, practice (in the sense of exercise problems), group problem solving, report writing, making presentations, group discussions etc., - a wide variety of instructional components are possible. Based on the CO and the competency, the instructor has to choose an appropriate mix of these instructional components.

(Refer Slide Time: 19:07)



Integration phase of Merrill: Essentially, learners should reflect, discuss with peers, defend their newly acquired knowledge and skills, and relate them to their existing mental model. This is very important if the learners have to retain their knowledge acquired for longer periods of time. Merrill also mentions that in several experiments it has been demonstrated that when the students are able to reflect on the newly acquired knowledge; when they are able to defend their point of view; when they are able to do a public demonstration; when they are able to critique their colleagues' peers' work; they are able to integrate the new knowledge better into their existing mental framework. In such instances, the learners are able to retain this for much longer periods.

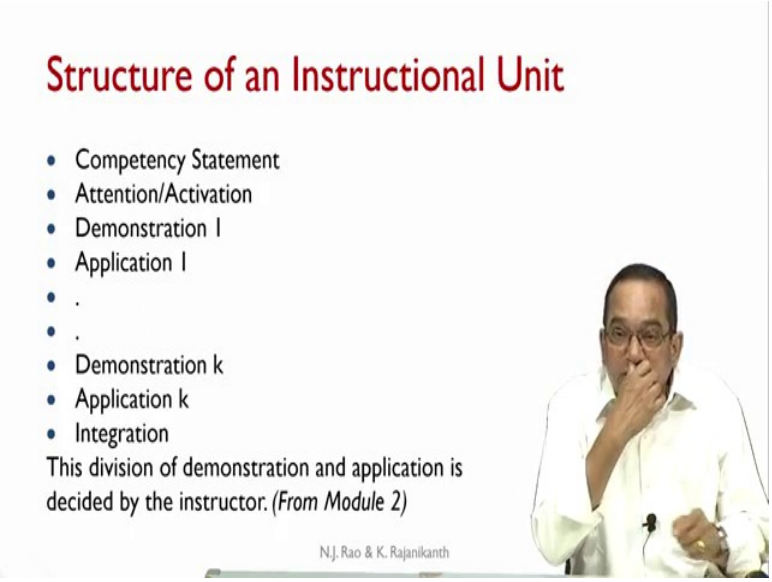
If there is a long time gap between this learning and the subsequent phase of trying to assess what is the extent to which they are remembering, it is possible that the students forget some specific details. But it has been found that the broad application context, the principles, the key features of the knowledge are retained by the students for much longer period when they do this kind of a reflection. Instructors must encourage the learners to engage in this integration phase; it is very essential.

(Refer Slide Time: 20:52)

Instructional components can be again - discussion in the classroom, group discussion, quiz, and summarization. In fact, another good thing can be some kind of maintaining a journal in which they record their reflections. Of course, instructor may have to train the students in how to write and maintain the journals because all of them may not be familiar.

In fact, with many of the instructional components, the instructor may have to ensure that the students are familiar with that component - how to do that. So, if required, the instructor may have to provide additional information, additional direct instruction to the students on how to use this and this phase is essentially the one where the consolidation of the new knowledge acquired happens. So, this should not be ignored and this must be appropriately handled by the instructor.

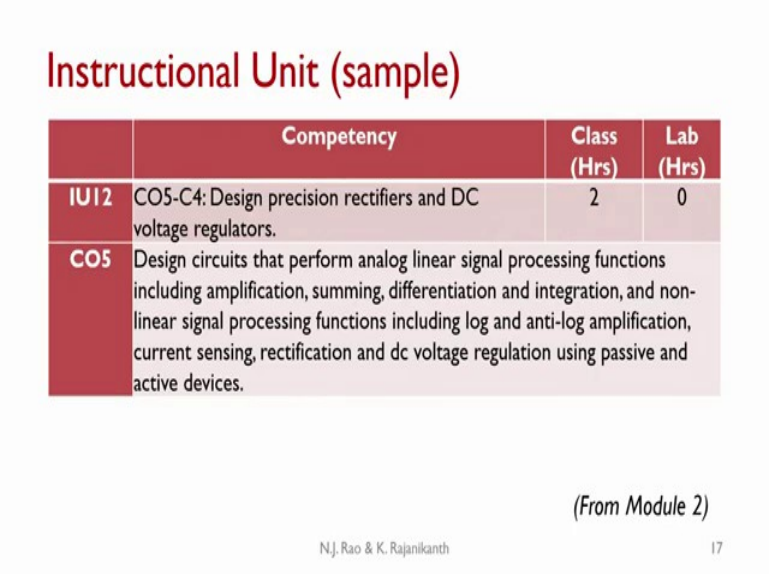
(Refer Slide Time: 21:50)



Structure of the instructional unit which we discussed earlier in module 2 is shown here. First, we have the competency statement or the statement of the course outcome; then attention/activation. Then we have a cycle - the demonstration followed by application. The number of times this cycle is repeated is totally dependent on the course outcome or the competency and is decided by the instructor. This division of demonstration and application is decided by the instructor and finally, integration phase.

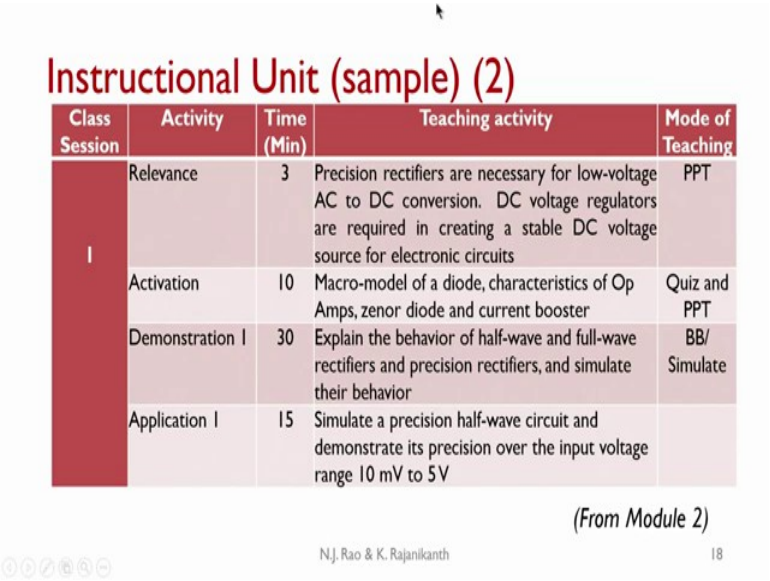
As mentioned earlier, the instruction unit could be associated with a course outcome or if there is sufficient scope and complexity, it could be associated with one specific competency also; i.e., the demonstration-application cycle can happen at the level of a course outcome or at the level of a competency. It is again the discretion of the instructor. And this, which we discovered earlier, now, we can see that it is basically derived from Merrill's model. It implements Merrill's five first principles of learning; that is how this instructional unit structure was presented earlier.

(Refer Slide Time: 23:14)



This example is also taken from the earlier unit - Module 2. You can see that here, there is a CO and that competency is that 'design precision rectifier and DC voltage regulators;' how many hours and the particular CO is also specified.

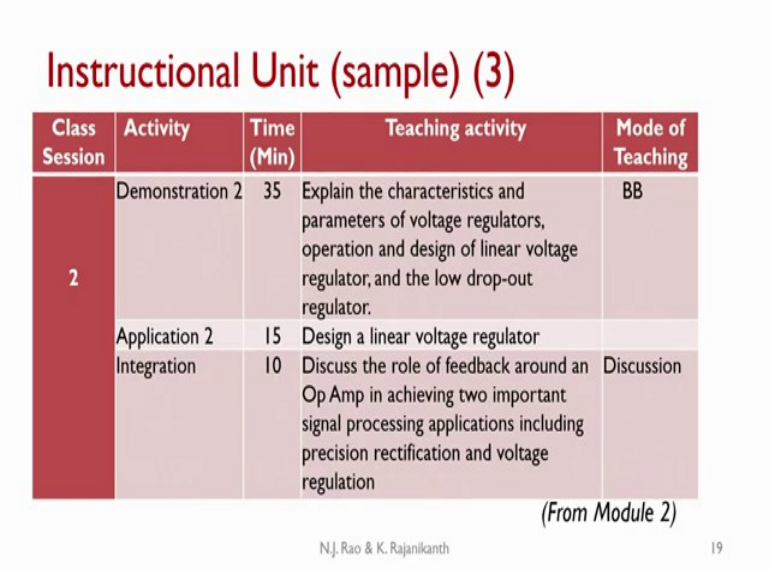
(Refer Slide Time: 23:40)



Then it goes through the relevance which essentially is what we called as the attention, i.e., making it clear to the students how this particular competency is relevant to their profession. It need not be very elaborate. As you can see here, it is only for 3 minutes, but it is fine. What is essentially is that the students see the relevance of what they are

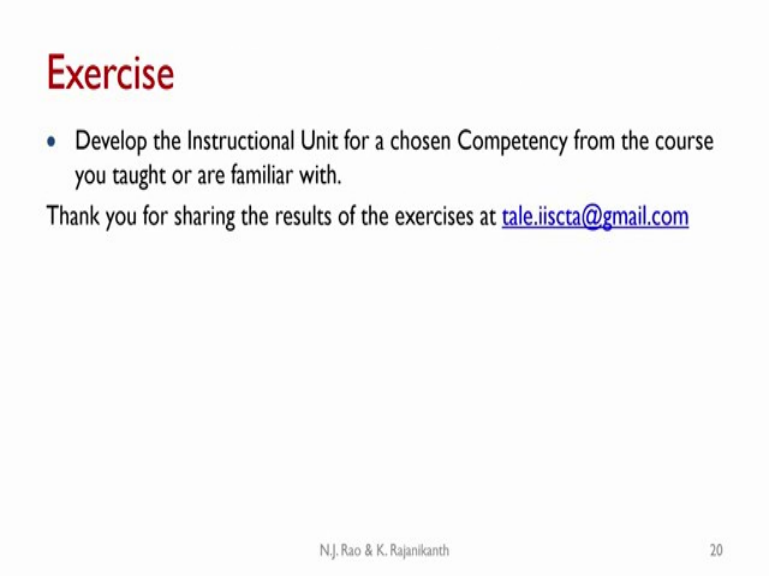
learning to their profession. Relevance, then activation, then we have demonstration 1, application 1. Then, we have again demonstration 2, application 2.

(Refer Slide Time: 24:17)



This could be more cycles depending upon the specific competency that is involved. In this example we are having only two cycles; there is demonstration 1, application 1 followed by demonstration 2, application 2. Then, there is an integration phase and here the instructor has chosen to use discussion as the instructional component to facilitate the integration phase. 'Discuss the role of the feedback around an Op Amp in achieving two important signal processing applications including precision rectification and voltage regulation' – and the mode selected is discussion. This is how the instructional unit is designed implementing the five learning principles of Merrill.

(Refer Slide Time: 25:12)

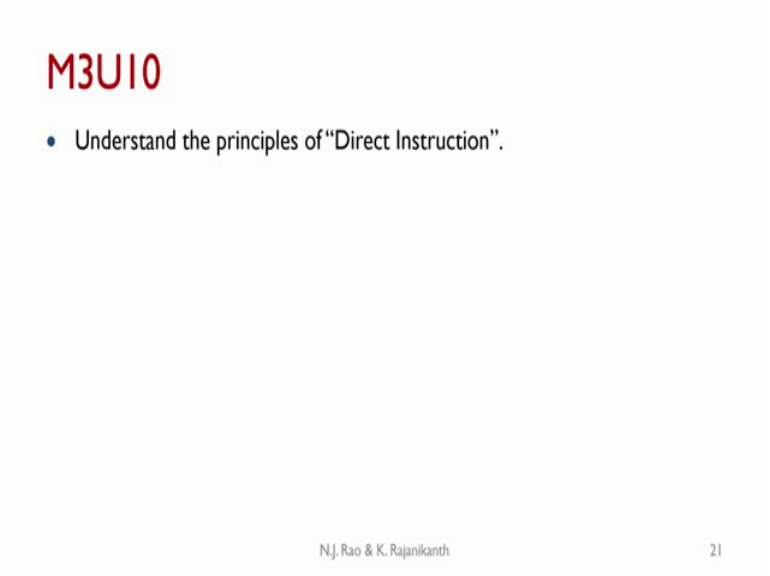


Develop an instructional unit for a chosen competency from the course you taught or you are familiar with. These exercises was there in earlier unit also, but now specifically focus on implementing all the five first principles of learning of Merrill and if possible actually relate the appropriate Merrill's principle to the specific components that you are designing and the specific instructional components that you choose. If you can give an explanation of how that facilitates that particular Merrill's principle, that would be of great help.

It would be a good way of showing how Merrill's principles are prescriptive in nature, in the sense, how they help the design of instruction. Just they do not only describe what is there, but it tells what should be there. It is prescriptive in nature, and doing this kind of an exercise would help us to understand how to use Merrill's five first principles of learning in order to design instruction.

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

(Refer Slide Time: 26:33)



In the next unit, we will understand the principles of direct instruction. A classical model of instructional design, probably one with which most of us are familiar, but still we will try to look at it in a more systematic fashion, and we will see what are the basic components of direct instruction, what are its strengths and limitations, and what are the principles on which the direct instruction is placed.

Thank you for being with us, and we will meet you with the next unit.