TALE - 2: Course Design and Instruction of Engineering Courses

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Lecture – 24
Instructional Components – I

Greetings and welcome to TALE Module 3 Unit 6 on Instructional Components.

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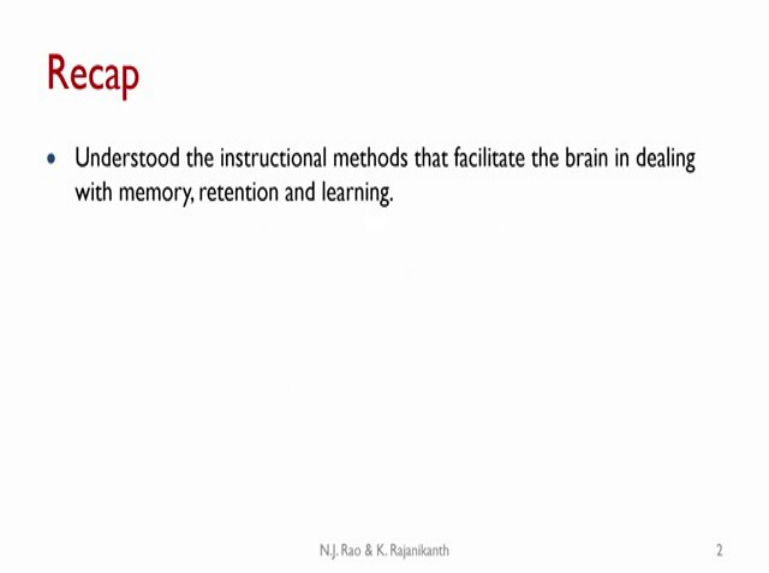

In the earlier units of Module 3, based on the structure and our understanding of the brain, and how some of the instructional methods can be made use of. We mainly looked at how the memory is formed, how we retain something in the memory, and what do we really understand by learning, and what is involved in the process of learning.

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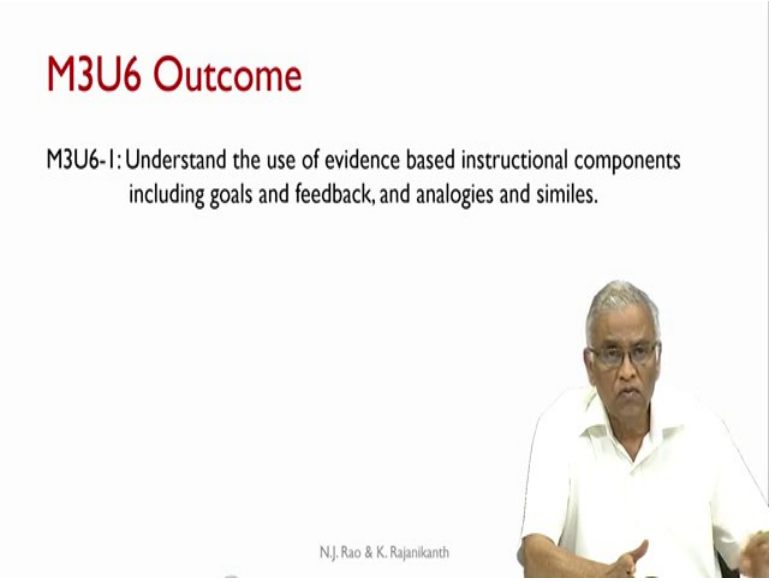

How do we actually do certain activities in interacting with the students in a classroom to achieve our required learning; (whatever we call learning, we will once again review what we mean by learning.) In this unit, we will look at some instructional components, which are the types of instructional activities that are independent of the content. These components can be used in any type of course.

We look at some instructional components which we consider most important. There are two we are going to look at in this unit; one is goals and feedback, and the other is analogies and similes. Our focus in this unit will be looking at their role and how exactly one should make use of them.

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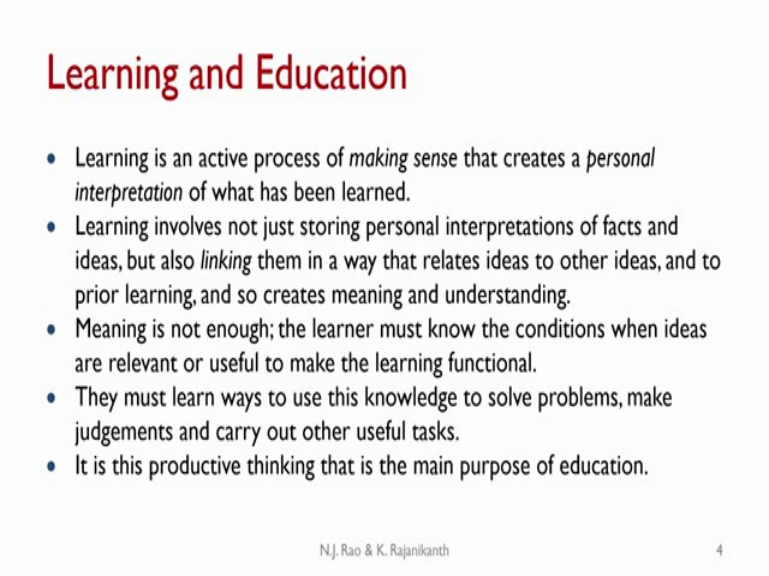

We talked about learning and education extensively in both TALE 1 and TALE Module 2 as well, but once again, let us do a review. Learning is an active process of making sense that creates a personal interpretation of what has been learned. Please note that while something is received, you will only put it into the memory and retain it, provided that you add your personal interpretation of what has been learned. But learning involves not just storing personal interpretations of facts, because each one of us may interpret a given fact differently.

But one of the requirements of retention is linking them in a way that relates ideas to other ideas and to prior learning and so creating meaning and understanding. That is what really constitutes learning in the context where we are right now operating. Once again, the meaning is not enough; the learner must know the conditions when the ideas are relevant and are useful to make the learning function. For example, when to use, in what context to use, when can I use this learning that I have; that is also part of the learning.

The students must learn ways to use this knowledge to solve problems, make judgments, and carry out other useful tasks. All these activities are involved in what you call learning. This productive thinking is the primary purpose of education. When you say education, it is the learning with all these features all these abilities.

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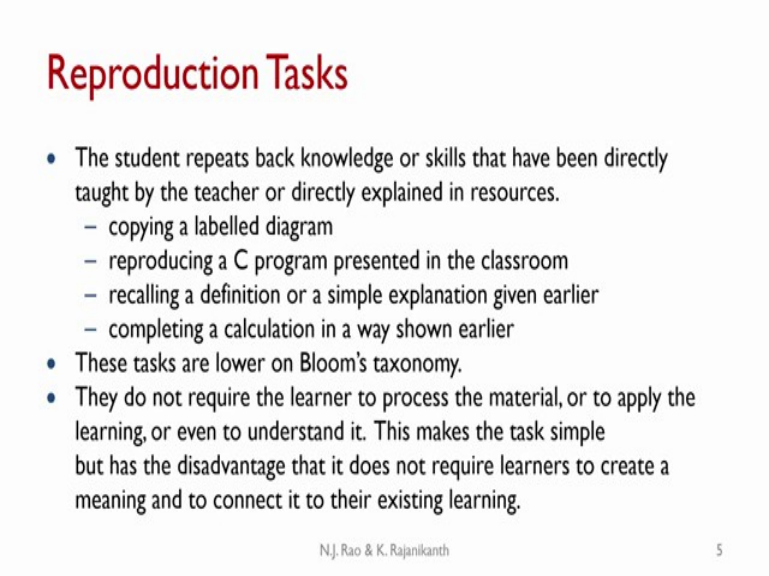

There are two types of tasks, one is the reproduction task, and the other is a reasoning task. Let us look at reproduction tasks. The student repeats back knowledge or skills that have been directly taught by the teacher or directly explained in resources. (Resources we mean, the textbooks, internet resources, etc.). When a student is trying to reproduce the information, he is reproducing it more or less verbatim or with the minor changes in the language.

But the focus is on reproducing or repeating the knowledge that is presented to him. For example, copying a labeled diagram - the teacher draws a diagram in the classroom on board, and then he labels each one of the elements, and the student is expected to remember that reproduce that.

For example, the way problem solving with programming is being taught in engineering courses, the students are taught a certain number of programs mostly in 'C' presented in the classroom. The student is expected to reproduce them in the written examination or reproduce it in the laboratory and make it function, or recall the definition or a simple explanation given earlier.

Defining something, completing a calculation in a way shown earlier, and even proving a theorem that is presented in the classroom are expected to be reproduced. There are a series of steps that student is required to perform to solve a problem, and you expect the student also to reproduce those steps and solve the problem. These are reproduction

tasks. When you look at these tasks, they are lower on the Bloom's taxonomy levels, which means almost they come at the level of recall level or occasionally at executing level in the Apply category.

These reproduction tasks do not require the learner to process the material or to Apply learning or even to Understand it. That means I can reproduce whatever I was asked to produce without even understanding it. I remember the material, and I reproduce. While this kind of thing makes the task simple but has the disadvantage that it does not require learners to create meaning and to connect it to their existing learning. That means as we explained earlier, the activities that are involved in transferring the knowledge or information from the working memory to the long-term memory and retain it. Those tasks are not required necessarily in reproduction tasks.

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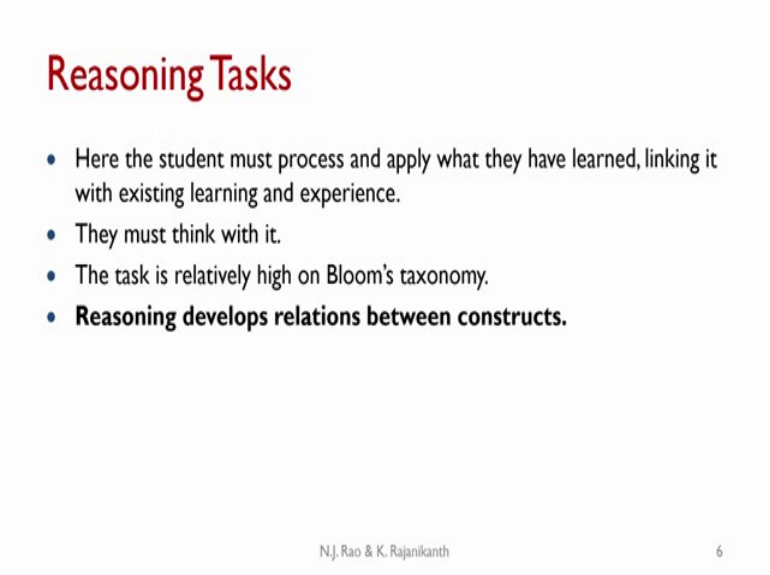

Reasoning tasks: The student must process and apply what they have learned, linking them to the existing learning and experience. Note that we are using the words 'linking it with existing learning,' this linking is a process from the units where we explored how brains learned, we were continuously using the word linking it with one group of engram/s connected to other engrams.

The word 'linking' is regularly used that is involved in good learning. While doing so, they must think with it, the task is relatively high on Bloom's taxonomy, and higher cognitive levels need to be addressed. The reasoning develops relations between the

constructs or between engrams. That means widely different small networks are interconnected, so that way, the moment one network is invoked, the other networks also get involved with that. You lead to such things when you have reasoning tasks.

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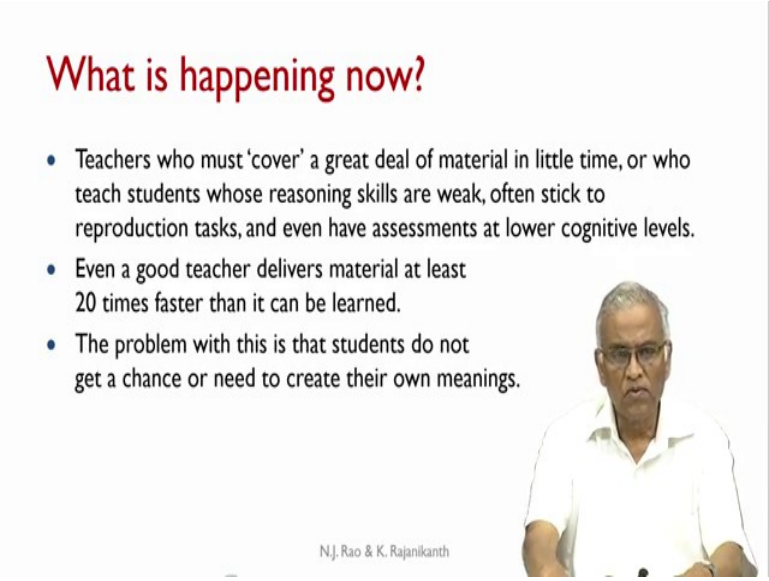

What exactly is happening as of now in the majority of the colleges? The teachers who must cover a great deal of material in little time or who teach students whose reasoning skills are weak, often stick to reproduction tasks and even have assessments at lower cognitive levels. This is happening implicitly and not intentionally.

When the curriculum is heavily loaded, that is, the content of a particular course is vast, or when a wide range of students with different cognitive abilities, the entire system seems to be adjusting itself over a period of time to or making the teachers stick to the reproduction tasks. When you stick to the reproduction tasks mainly in the classroom, the assessments have a way of coming down in the cognitive levels.

Even a good teacher who can explain does communicate well to the students, etc., as per one number (this number 20 is not an absolute thing,) delivers materials at least 20 times faster than it can be learned. Of course, this 20 applies to weak learners; fast learners may be able to keep up with the time. But still what happens is the amount of time the teacher is forced to take is not sufficient to facilitate the students to learn because learning requires a certain amount of time to process the information.

Because of that, the students do not get a chance or need to create their own meanings. Even the students are being pushed to abandon their effort to create their own meanings, and somehow resort to learning through reproduction or mainly focus on reproduction.

Of course, this is not universally true, some good students do manage in spite of all these, they put extra effort, they are inherently capable of absorbing the information and working out the logic and apply all the reasoning and learn well, but that is not because of what is happening in the classroom.

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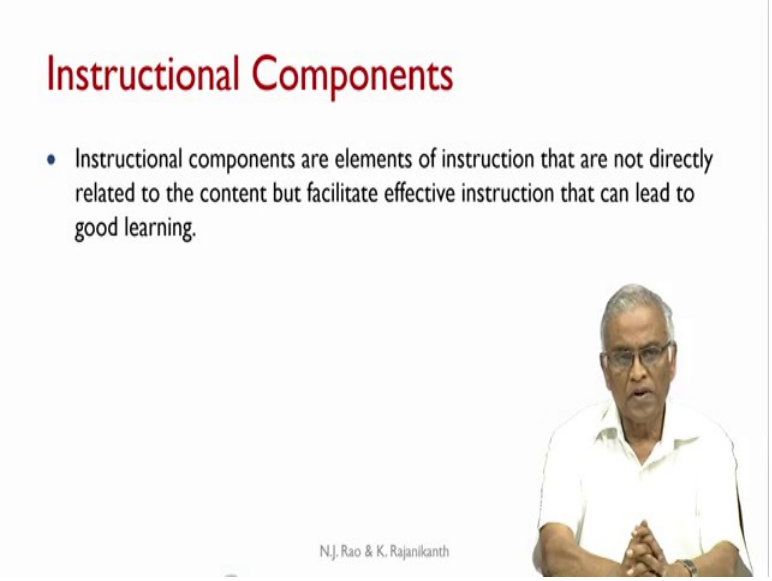

Now we look at formally the instructional components: what are instructional components? Elements of instruction that are not directly related to the content; that means, whether I am teaching electrical engineering or fluid mechanics or operating systems - irrespective of the subject. But if I use these instructional components in my actual classroom instruction, they facilitate effective instruction that can lead to good learning; that is what instructional component is. That means, when I want to teach something, I may want to use a series of instructional components and sequence them in my own particular way.

There are a large number of instructional components (in fact, literature reports 60 to 70 instructional components). Some of them may be overlapping, but there is large number of instructional components created by good teachers, and they have been researched,

and their effectiveness is also measured so that we can convince ourselves that we can make use of these instructional components.

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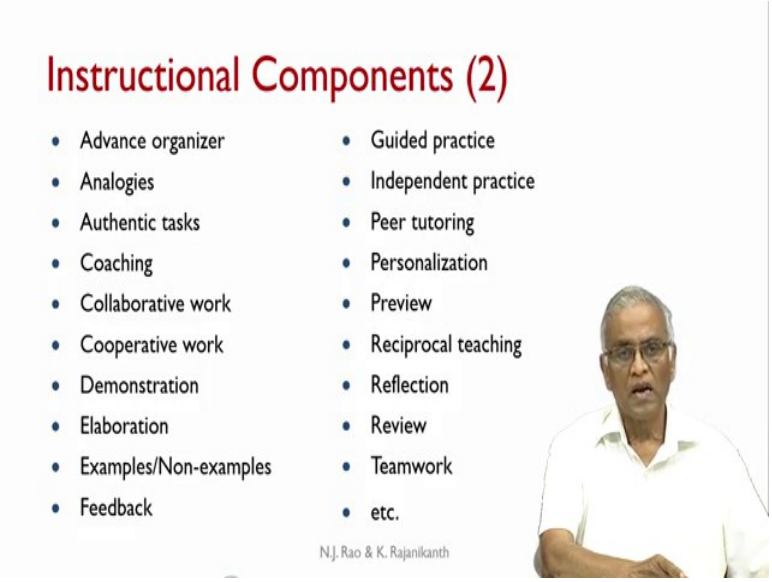

Let us look at some samples, reported in one place (these are arranged alphabetically not necessarily in terms of its importance.) For example, advance organizers, analogies, authentic tasks, coaching, collaborative work, cooperative work, demonstration, elaboration, examples, non-examples, feedback, guided practice, independent practice, peer tutoring, personalization, preview, reciprocal teaching, reflection, review, teamwork, etcetera.

We will pick a few of them in the current unit and the following unit and look at these instructional components; what is the intent behind it, how it can be implemented. Considerable accumulated experience exists with some of the instruction components. Some of these instruction components are more effective than others. But once again, if it is effective in an instance, it does not mean that it will be equally effective in some other context. That is where the instructional situational factors will come into the picture. But by and large, there are specific instructional components that will have maximum impact. Let us look at some of them.

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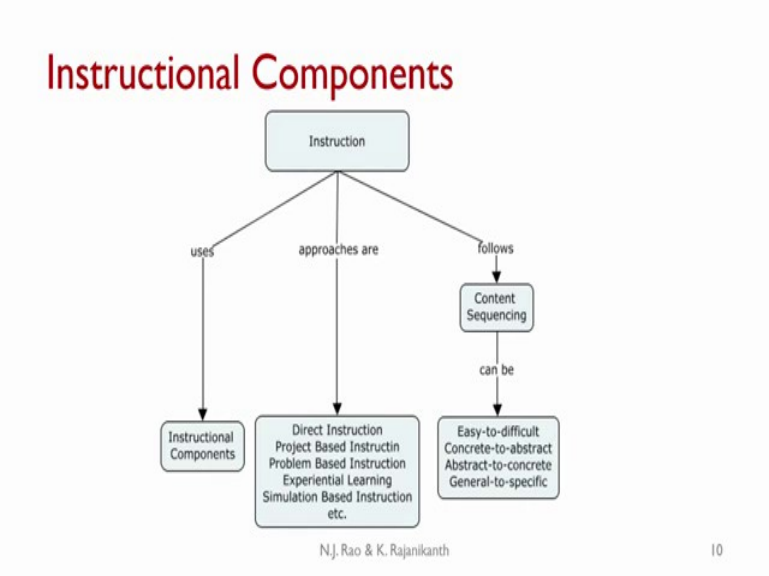

Given is the diagrammatic representation of instructional components in the broad context. The entire Module 2 is related to instruction, so when you do the instruction, you are following some approach. We will be looking at these instructional approaches in the following units. For example, these approaches could be direct instruction (I would not call it classroom lecture, but direct instruction or face-to-face instruction), project-based instruction, problem-based instruction, experiential learning, simulation-based instruction, and so on.

There is also a choice with regard to content sequencing. This is a preference for individual teachers. For example, you may want to start with easy-to-difficult problems/ concepts, concrete-to-abstract concepts, or abstract-to-concrete concepts.

When you have very bright students in your class, they will be impatient if you try to go slowly from easy-to-difficult things; they say you just give me the total picture, and they are capable of capturing the same. So, abstract-to-concrete is one of their ways of doing it or general to specific and so on.

The instruction uses a wide range of instructional components. So, any approach that you take let us say ‘direct instruction.’ The teacher can make use of any of the instructional components he considers appropriate to the specific course outcome he/she is addressing or based on the nature of the subject, as well as the resources available, and so on. All the choices are made by the teacher.

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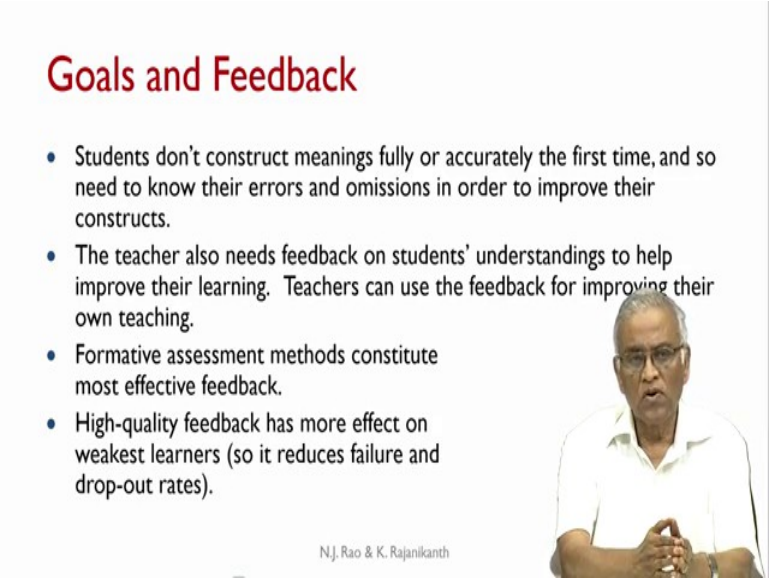

The most important of all the instructional components are 'goals and feedback.' Whenever a student is trying to learn first time a concept or a principle or a specific procedure, the student does not construct meaning fully or accurately the first time. When it is presented the first time, they will not be able to fully or accurately connect one concept to the other. They will commit some errors (even bright students also may commit some errors, or sometimes they even omit.)

Students need to know what the errors they are committing, and what are the omissions they are making to improve their constructs. If they make mistakes in the way they are constructing the knowledge in their brain, then their ability to apply accurately in a new situation will not be right. One of the roles of a teacher is to ensure as far as possible, these constructs are created correctly in the brains of the learners.

One of the ways a teacher is trying to give feedback to the students on where the omissions or errors are occurring. The teacher also requires this feedback on students understanding to help improve their learning. Unless the teacher finds out, he will not be able to give useful feedback to improve learning.

The teacher can use this feedback himself or herself to improve his/her own teaching. For example, if you regularly observe that the students seem to be making some errors repeatedly, it becomes feedback to the teacher that he or she should ensure in their teaching that those errors do not occur.

The most effective feedback is provided by the formative assessment methods. Formative assessment methods mean you are asking them to do something, used only for facilitating learning, but not for contributing to the final grade. When your feedback is of high quality, that is, you are going to be specific and detailed, it has maximum impact on the weakest learners.

As we have institutions of various kinds, one of the concerns of many of these colleges is to ensure that the pass percentages are very high or reduce failures (failure is also expensive both to the student and the institution.) In order to reduce failures, one of the methods is to provide high-quality feedback. We consider providing high-quality feedback is of the highest value in instruction.

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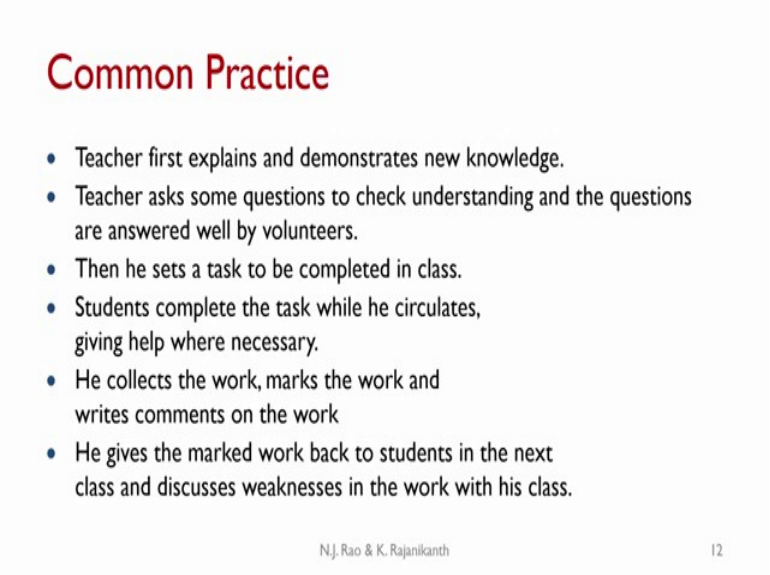

Let us look at two different practices. One, we call it 'common practice' and the other 'good practice.' Sometimes even this common practice does not take place effectively, that means the teacher presents something in the classroom, and there may or may not a tutorial that is included. So, the only way the student will know whether he has learned something or not is only when the examination is conducted. As we all know that even the so-called home assignments are also not that very effective because when the student does not see much value in that, the students tend to copy from each other. It is not because they cannot do it; it is just convenient not to do it.

Let us look at the sequence of steps of in so-called common practice, which itself is, in my opinion, is reasonably good. The teacher first explains and demonstrates new knowledge that generally happens in the classroom. The teacher asks some questions to check the level of understanding, and the questions are answered well by the volunteers. Volunteers mean only there are a few students who will raise their hands and answer the questions, and the others remain quiet. Then the teacher sets a task to be completed in the class. This dominantly happens if you have an effective tutorial session.

Students complete the task while he circulates, giving feedback wherever necessary. At the end of the session, takes the work/files of all the students, marks the work and writes comments on the work. He gives the marked responses back to students in the next class and discusses weaknesses in the work.

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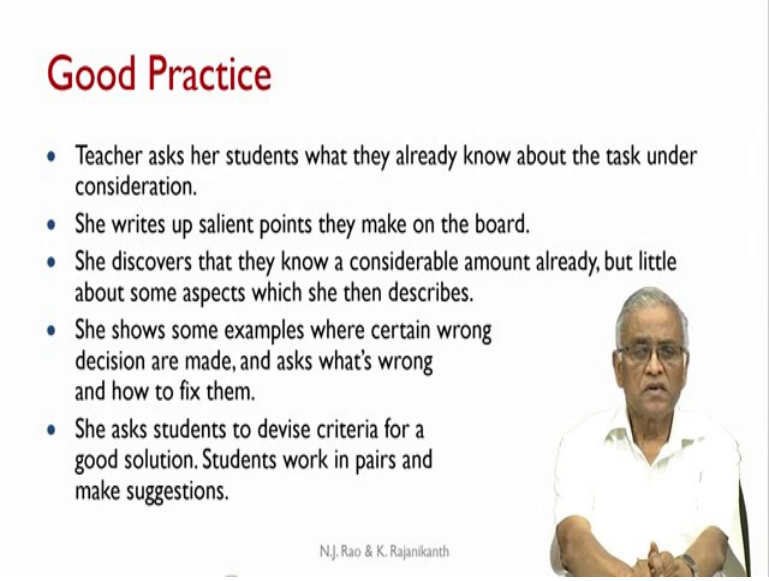

Let us look at what we consider as a good practice. The teacher asks her students what they already know about the task under consideration. For example, if the problem is to be solved, the teacher presents the problem and first asks the students what is it that they already know about the task. And she writes salient points they make on the board. So, different students make different points. She discovers that they know a considerable amount already, but less about some aspects which she then describes, that means, wherever she finds gaps in the points they made, she will then explain.

Then the teacher shows some examples where some wrong decisions are made and ask what is wrong on how to fix them. You learn by identifying the errors committed, and she asks the students to devise criteria for a good solution.

What constitutes a good solution to the problem on hand, and this is where the students work in pairs, they discuss with each other and make suggestions saying that this is what they consider a good solution.

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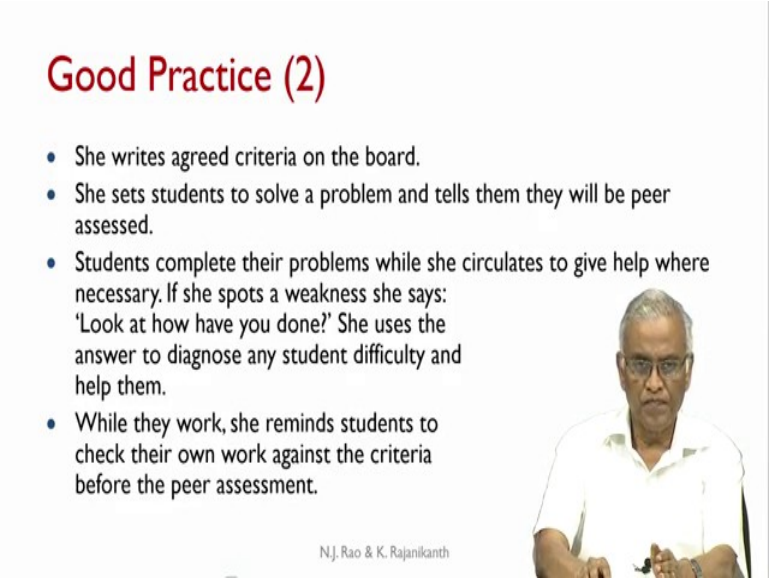

She writes the agreed criteria on the board. She sets the students to solve a problem and tells them they will be peer-assessed; that means, everybody's solution will be assessed by somebody else. Students complete their problems while she circulates to give help where necessary. If she spots a weakness, she says, 'look at how you have done?'

She uses the answer given by the student to diagnose the difficulty and help them. While they are working, she reminds students to check their own work against the criteria before the peer assessment. That means the criteria written on the board and have worked out a solution; they should make sure that all criteria written on the board are met with by the solution created by them.

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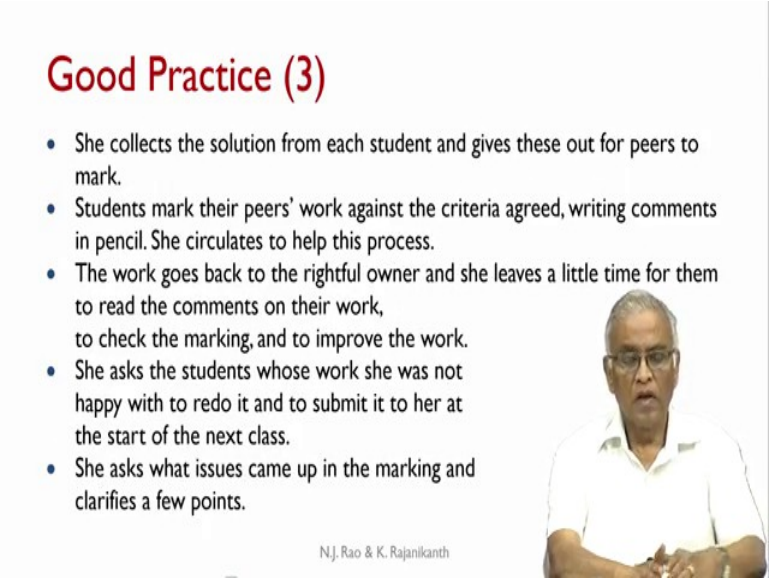

Then the teacher collects the solution from each student and gives these out to peers to mark. A simple method can be worked out in which the student writes his or her name on the paper. Student marks their peer's works against the criteria agreed, writing comments in pencil, and she circulates to help this process again. When you are correcting others in that process, also one would learn. The work goes back to the rightful owner, and the teacher leaves a little time for them to read the comments on their work to check the marking and to improve the work.

She asks the students whose work, and she was not happy to redo it and submit to her at the start of the next class. In spite of all these, some students may not be able to perform, so they were asked to submit the next day. She asks what issues came up in the marking and clarifies a few points.

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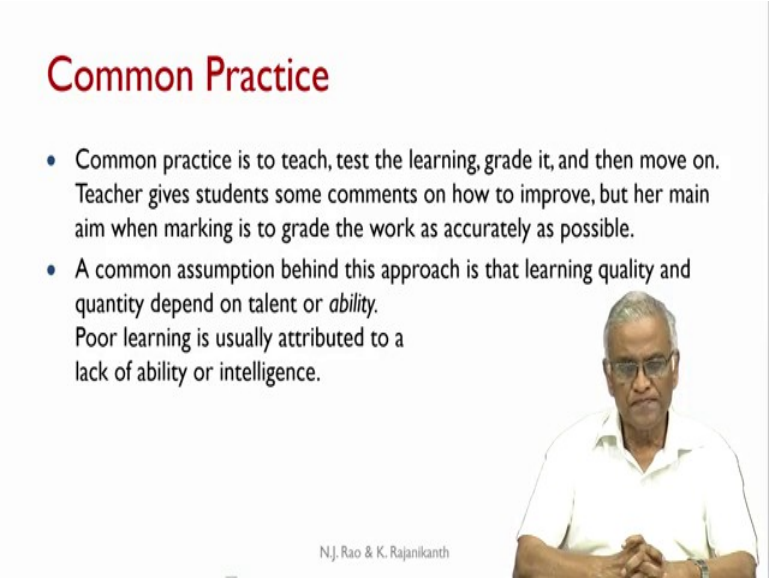

We looked at what we called common practice and good practice. If you look at this common practice is to teach, test the learning, grade it, and then move on. If this is done faithfully, it is already a significant improvement in currently what is happening. The teacher gives students some comments on how to improve, but her main aim when marking is to grade the work as accurately as possible.

A common assumption behind this approach is that learning quality and quantity depend on talent or ability. Poor learning is usually attributed to a lack of ability or intelligence. If you make that assumption and if any practice that you follow in on this so-called poor students will always remain poor.

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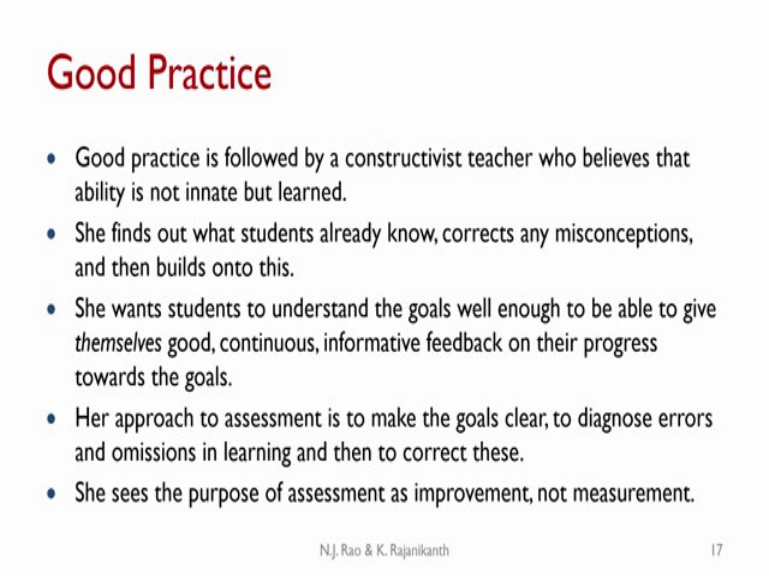

Good practice: initially it looks very complicated, there are too many steps involved in that. But in terms of the amount of time that is spent, in actuality, it is not as scary as it looks. The first thing is it is doable, and with some amount of practice, the teacher can optimize (because you are going to do this on a regular basis, one can master all the steps very well.) A good practice is followed by a constructivist teacher who believes that ability is not innate but learned. Some people can learn fast, but the ability to learn can be learned.

She finds out what students already know, corrects any misconceptions, and then builds on this. She wants students to understand the goals well enough to be able to give themselves good, continuous, informative feedback on their progress towards the goals.

With respect to good practice, the goal is not merely teachers giving feedback to the students. These students should be able to give good continuous informative feedback. Finally, the students should be able to know how exactly they are doing; if they can find faults with what they are doing, they will be able to take corrective steps and continuously improve. It means their ability to learn by themselves will significantly improve.

The teachers' approach to assessment is to make goals clear, diagnose errors and omissions in learning, and then correct these. She sees the purpose of assessment as

improvement and not a measurement of learning because, as we said in the beginning, the dominant method of providing feedback is through formative assessment.

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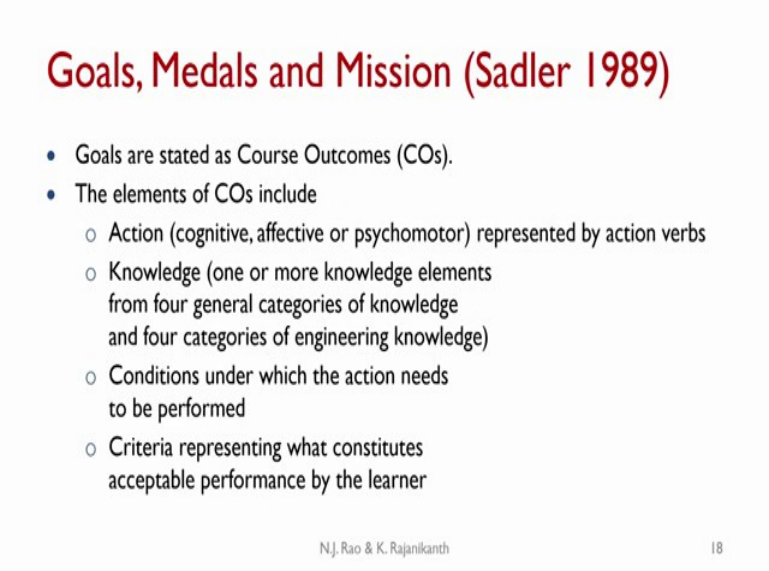

These three words, goals, medals, and missions are introduced by Sadler. Those are the words that we can use without confusing or making our lives complicated. Goals are stated as course outcomes with which we are familiar, how to write course outcomes, and what exactly they are. And we have seen the elements of course outcomes include action, (if you are really are very well versed, they can belong to cognitive, affective and psychomotor, represented by corresponding action verbs) knowledge (from four general categories of knowledge and four categories of engineering knowledge,) conditions, (under which the action needs to be performed) and criteria, (representing what constitutes acceptable performance by the learner) what constitutes a good solution.

If you recall in TALE 1, we talked about these four elements in writing a CO. In these four elements, action and knowledge elements are compulsory, whereas conditions and criteria are optional. Goals are nothing but course outcomes. But the goals have to be stated very clearly, and that is the reason why course outcomes should be written with care.

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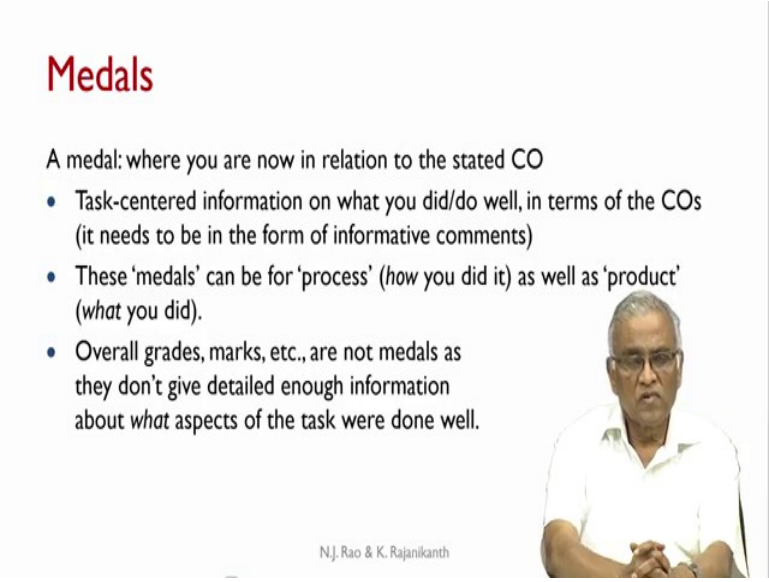

Medal: that is you give yourself a medal, what does it represent? Where you are now in relation to the stated CO, because this is what I am required to solve, and I have been through my listening in the classroom and solving problems, this is where I am. The medal states that where exactly you are, that is task-centered information in what you did or do well in terms of the COs, it needs to be in the form of informative comments.

These medals can be for the process. You followed the procedures correctly, and we are also interested in the product. So, the medals can be process-related medals or product-related medals. Overall grades, marks, etcetera are not medals as they do not give detailed enough information about what aspects the task is done well.

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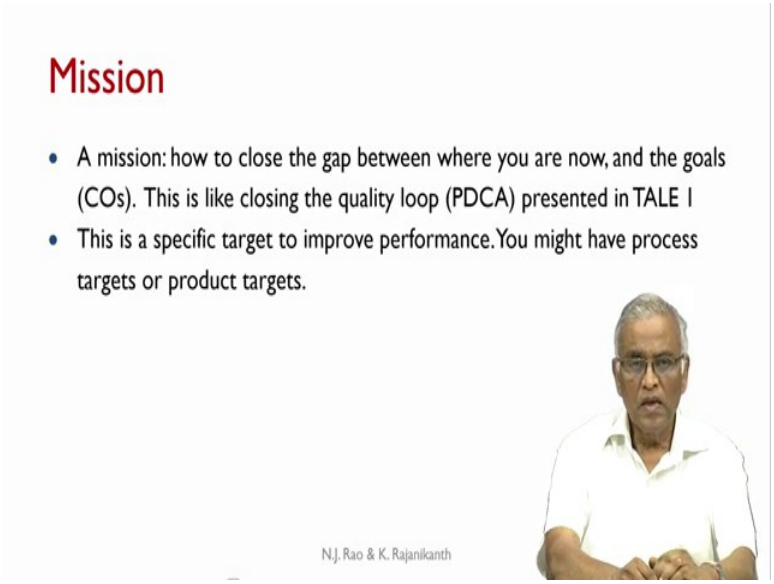

Then the mission is - if I know where I am, and how do I reach my target? I need to set up my intermediate goals - if I am here, what are the series of steps that I need to go through before I can finally reach the target. It is approximately equivalent to the quality loop (mentioned in TALE 1) called PDCA. For continuous improvement, the Deming cycle has been defined as PDCA, and it is almost the same. This is a specific target to improve performance; you might have process targets or product targets.

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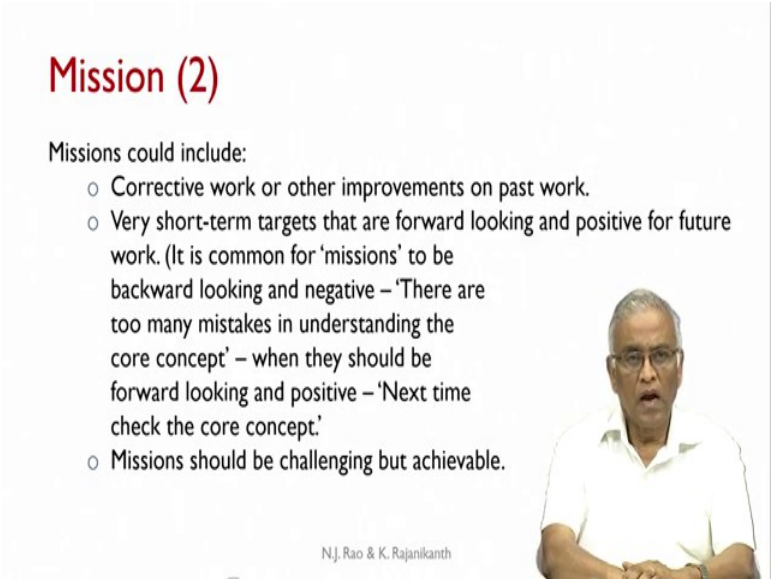

The missions could include corrective work or other improvements on past works, what exactly I should do, or short-term targets that are forward-looking and positive for future work. It is common for missions to be backward-looking, saying that there are too many mistakes in understanding the core concept. When there should be forward-looking and positive, next time, make sure you check out these core concepts, that is the way the feedback needs to be given. A mission should be challenging enough, but achievable, that are the characteristics of the mission.

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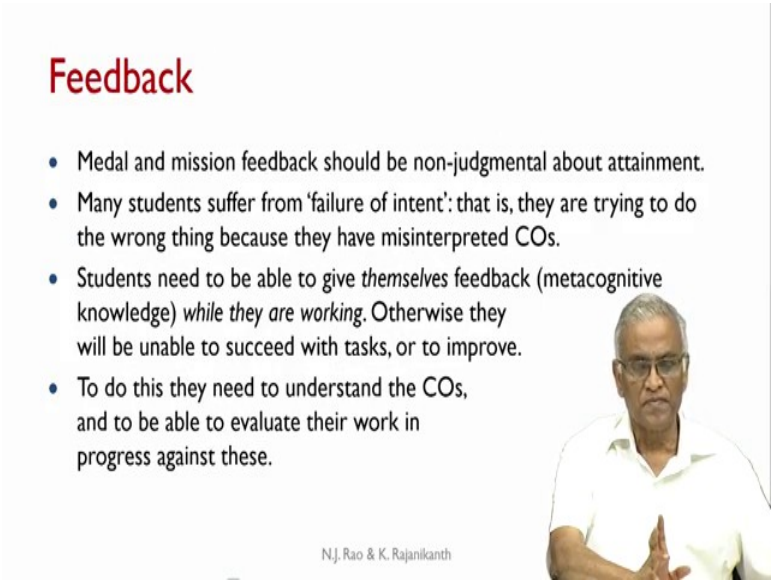

To summarize the feedback - medal, and mission: feedback should be non-judgmental about attainment. Because it is only formative assessment, you are not giving grades, and under no circumstances, one should negatively comment on the student. Many students suffer from the failure of intent; that is, they are trying to do wrong things because they have misinterpreted COs.

One of the things a teacher needs to understand clearly is whether the students have understood the CO or the competency. Students need to be able to give themselves feedback, which we defined as metacognitive knowledge; otherwise, they will be unable to succeed with tasks or to improve.

To do this, they need to understand the COs and to be able to evaluate their own work-in-progress against these. As you can see, the processes involved and the ability to make use of one's own feedback and the so-called meta-cognitive knowledge that means to

find out where you are and what you are required to do. These are all required elements to make effective use of feedback.

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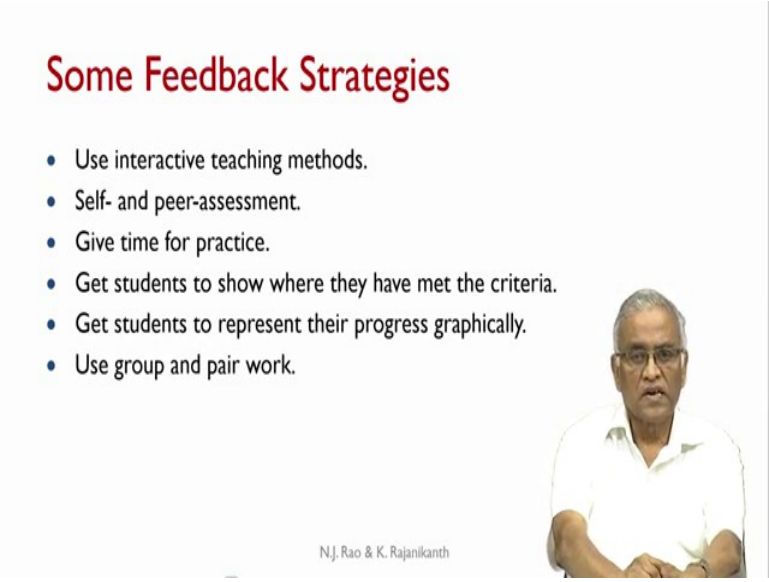

What are some of the feedback strategies a teacher can make use of? use interactive teaching methods, self, and peer assessment, give time for practice, get students to show where they have met the criteria, get students to represent their progress graphically. This kind of graphic representation of one's own progress is drawn by the student, not by the teacher.

The student can maintain in his own book with respect to a particular CO, he can draw a graph and say where exactly he is, and as he progresses, he can keep pushing the graph up. Use group or pair work that also will significantly help in the constructivist approach to learning.

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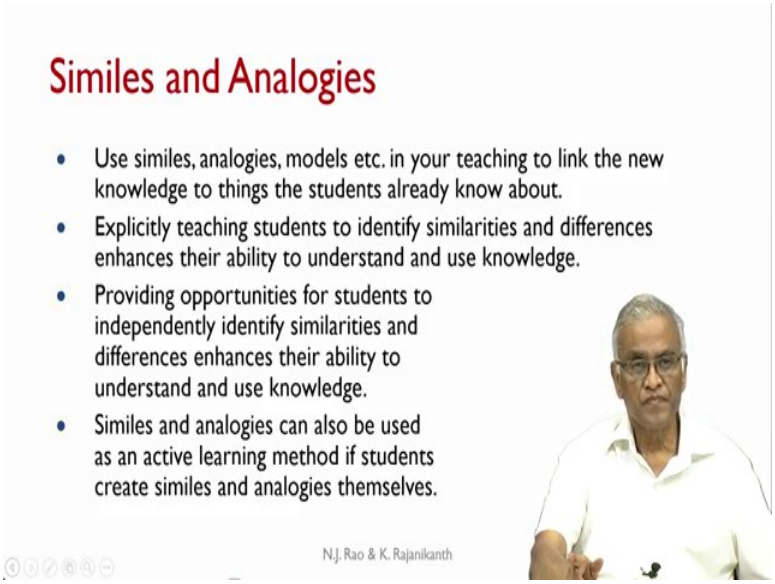

The following instructional component is "similes and analogies": Why they are important is, whatever new thing a student is trying to learn, should be connected to what the student already knows. One of the ways to find out what exactly they know, you can make use of similes, analogies, and models. The teacher should use similes and analogies. Some similes may make more sense to some students, and some other analogy may make more sense to some other group of students. Therefore it is necessary that the teacher uses as many similes and analogies that the teacher can make use of in the given time.

Explicitly teaching students to identify similarities and differences enhances their ability to understand and use knowledge. Similes do not mean it is identical; it is not the same; it is somewhat similar. For example – 'electricity is like water flowing through a pipe.' If you visualize water flowing through a pipe and current flowing through a wire and compare these two - there will be many similarities, but they will also have many differences. By looking at these differences, one will be able to understand, but still, the analogy or the simile that you are using is something that students already familiar with. Flow-through a pipe generally, the students would know by the time they would start with let us say their engineering program.

Providing opportunities for students to independently identify similarities and differences enhances their ability to understand and use knowledge. That means, instead of teacher

giving an analogy and make the students actually find out, identify for themselves, similarities and differences, for this one can use some graphic methods which will see in the later unit.

Simile and analogy can also be used as an active learning method if students create similes and analogies themselves. So, the next level is, you take a concept and ask them to identify simile or analogy for that - the student should construct the analogy now and justify that.

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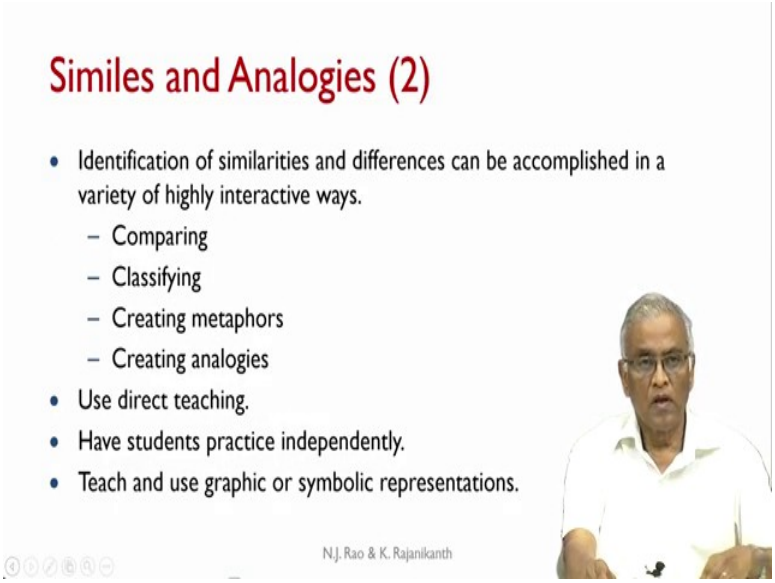

Identification of similarities and differences can be accomplished in a variety of highly interactive ways, like comparing, classifying, creating metaphors, creating analogies. These will all come under the category of (as per Bloom's taxonomy) ‘understand.’ If the teacher uses direct teaching, it can be practiced in the class. Have students practice independently, teach using graphic/symbolic representation. These are all the methods of using similes and analogies.

By creating this, you are interconnecting one neural network to another neural network. When they are connected to each other, it does not mean they are exactly identical, but they are similar. It still greatly helps to further the student to think and retain the information in the long-term memory better.

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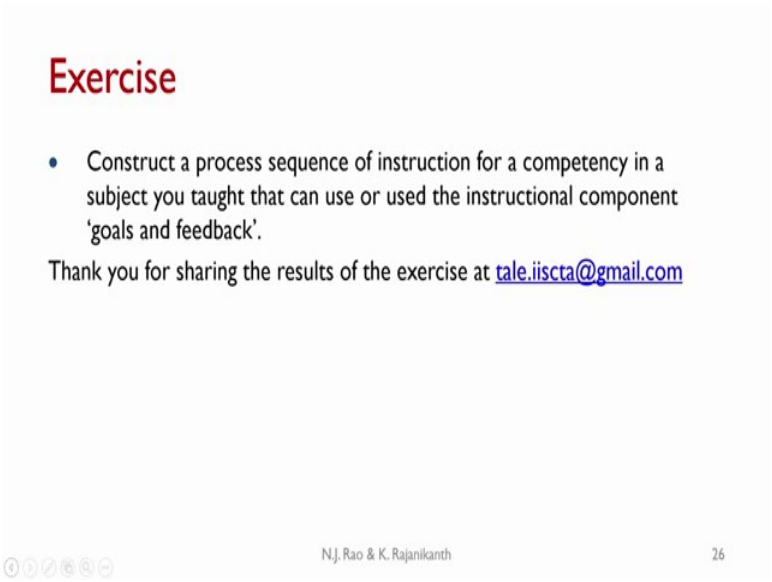

We request you to do an exercise - construct a process sequence of instruction for one competency in a subject that you taught, that can use the instructional component, 'goals and feedback.' If you have not used this, you can construct such a sequence yourself of setting goals and giving feedback on how far you are from the goal. We would appreciate it if you share the result of your exercise at this particular email tale.iiscta@gmail.com.

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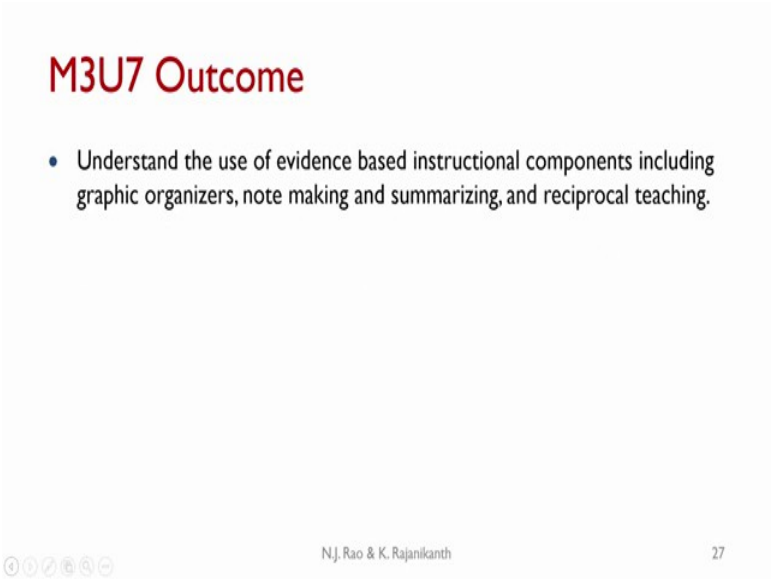

In the next unit, we will continue with some more instructional components, especially graphic organizers, note-making and summarizing, and some reciprocal teaching.

Thank you very much.